OCT 18 1943

The Engineer

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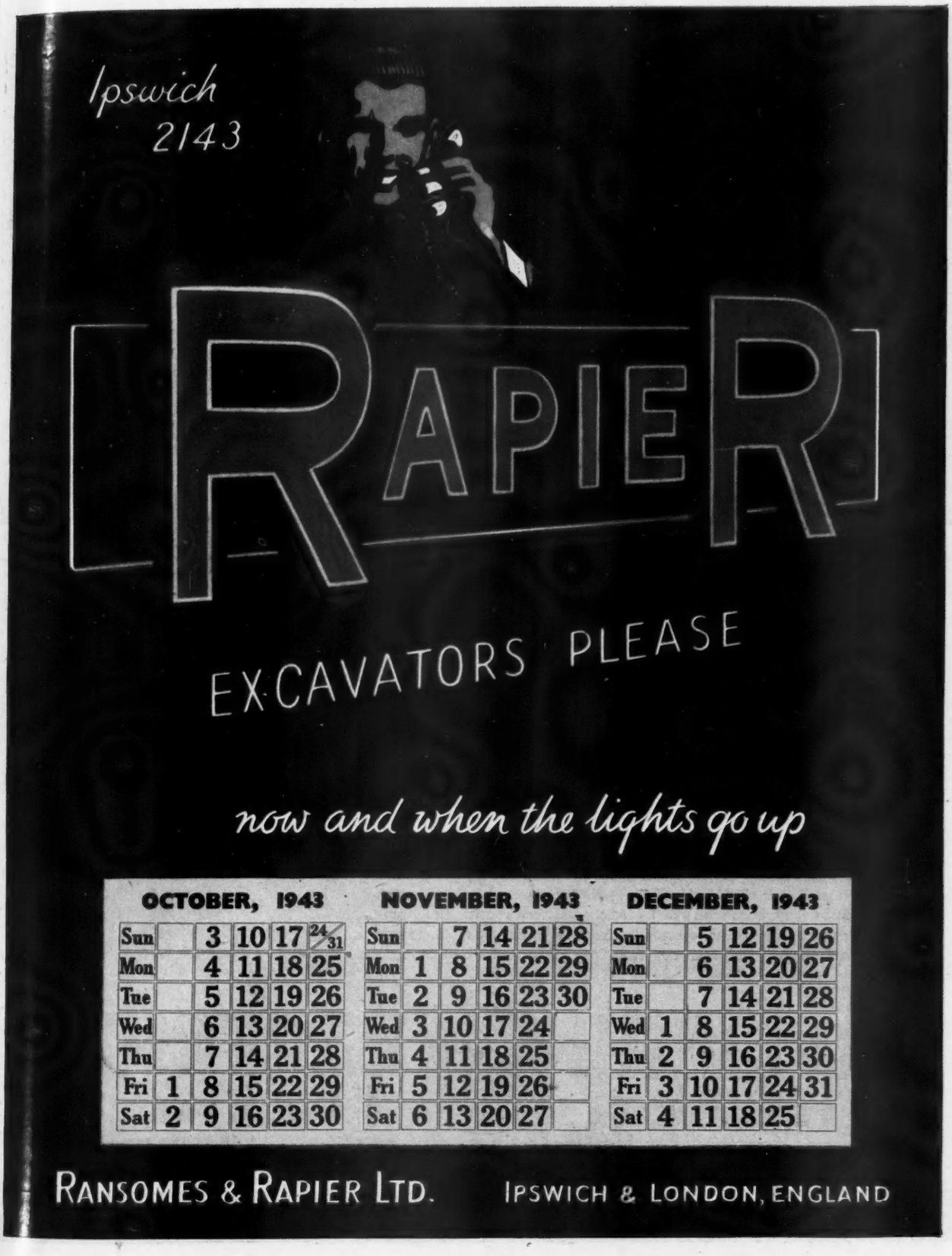
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OCTOBER, 1943
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Thu 7 14 21 28
Fri 1 8 15 22 29
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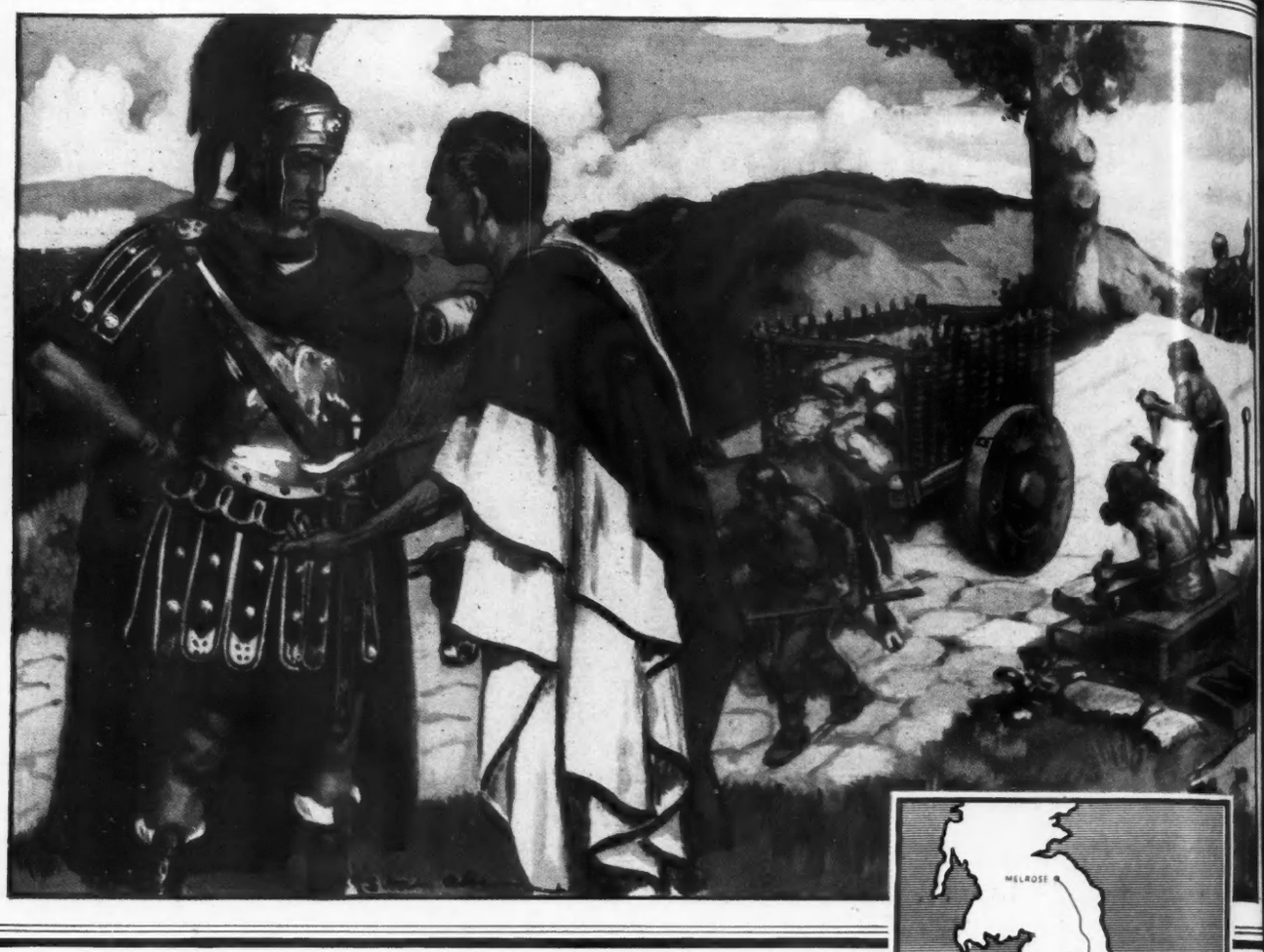

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First mentioned historically in the Treaty of Wedmore in A.D. 878, Watling Street is the first and most important of the roads built during the Roman occupation of 55 B.C.

Built primarily for the easier subjugation of the Britons it was also constructed in order to open up the country industrially.

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LEADERS IN ROAD CONSTRUCTION AND BUILDING PLANT

The Engineer

LONDON, FRIDAY, SEPTEMBER 24, 1943.

PUBLIC NOTICES

ice is Hereby Given that RICHARD LESTER WILCOX and THE BURY FARREL FOUNDRY and MA- COMPANY SEEK LEAVE to AMEND CIFICATION of LETTERS PATENT No. entitled "Improvements in or relating thod of and Means for Making Articles s Polygonal Cross Section." ulars of the proposed Amendment were th in the Official Journal (Patents) No. ated September 22nd, 1943. person may give Notice of Opposition to endment by leaving Patents Form No. 19 PATENT OFFICE, 25, SOUTHAMPTON DINGS, LONDON, W.C.2, on or before the tober, 1943. 8349

CITY OF LIVERPOOL

ELECTRIC SUPPLY DEPARTMENT

Corporation of Liver- POOL invite TENDERS for the CON- TION of GENERAL BUILDING WORK H BUNKER at the Clarence Dock Power

Contract will cover General Building Work onstructional Work, additional to and ted with other Contracts which will be in at the same time, for Civil Works and al Steel Work in connection with the extensions at the Power Station. ddition to the Construction of a Ferro- te Ash Bunker, the Contract will include iscellaneous Builders' Work, such as ork, doors, ironmongery, painting, asphalt- rasaltithic paving, together with items of oncrete work in the construction of flat nd suspended floors. s of Tender form with specification and quantities can be obtained on application City Electrical Engineer, 24, Hatton , Liverpool, 3. ications must be accompanied by a deposit s., which will be returned on receipt of a ide Tender. Tender must be enclosed in a sealed enve- endorsed "General Building Work— " and addressed to the Town Clerk, pal Buildings, Liverpool, 2, and forwarded h the post so as to be received by him not than the first postal delivery on Thursday, er 14th, 1943. Corporation do not bind themselves to the lowest or any Tender.

W. H. BAINES,
Town Clerk.

icipal Buildings,
Liverpool, 2. 8337

UNIVERSITY COLLEGE OF SWANSEA

e Council Invites Appli- CATIONS for the POST of PROFESSOR GINEERING. Minimum salary £1000 per m. It is hoped that suitably qualified s engaged in national service will apply. ther particulars may be obtained from the signed, by whom applications must be ed on or before November 20th, 1943.

EDWIN DREW,
Registrar.

gleton Park, Swansea. 8331

SITUATIONS OPEN

ES OF TESTIMONIALS, NOT ORIGINALS, UNLESS SPECIFICALLY REQUESTED.

ADVERTISERS UNDER BOX NUMBERS IN SITUATIONS OPEN SECTION.

the benefit of applicants, the Proprietors repared to insert brief notices that vacancies filled, upon receipt of notifications from the rtisers. These notices (limited to one line) be free of charge, and co-operation is for.

IMPORTANT

rtisers in Situations Open Column ld make themselves acquainted with erms of

TATUTORY RULES & ORDERS 1941 No. 2069

TRICTION ON ENGAGEMENT ORDER

NTED, a First-class WORKS PRODUC- TION MANAGER for well-known Boiler- g Firm; only those with long and prac- experience and with knowledge of up-to- methods and machinery will be considered. idual must be able to Control Workpeople possess vim and enterprise. Applications d in confidence.—Address, 8292, The Engi- Office. 8292 A

EMICAL WORKS, E.W.O., REQUIRE PLANT MANAGER, ENGINEER, or NIST. Salary £650.—Address, stating age, ence, and qualifications, 8341, The Engi- Office. 8341 A

The Engineer

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THE FACT that goods made of raw materials in short supply owing to war conditions are advertised in this paper should not be taken as an indication that they are necessarily available for export.

SITUATIONS OPEN

APPLICATIONS are INVITED for the POSI- TION of Qualified METALLURGIST, to be responsible for the Technical Control of a Heat Treatment Shop in the North Midlands, having a throughput of approximately 200 tons per month.

Applicants should be in possession of the Final Metallurgical Certificate of the City and Guilds of London Institute, or similar qualifications, and have had practical experience of Heat Treating Modern Alloy Steels, and be conversant with the Emergency Wartime Specifications. Experience of Tool Hardening, including the Use of Substitute High-Speed Steels, is necessary.

Knowledge of the Firing of Town Gas Fired Furnaces would be an advantage.

The successful applicant will be required to undertake a certain amount of night work.

Applicants should state age, qualifications, and salary required, and position under the Essential Works Order.

Address, 8339, The Engineer Office. 8339 A

A WORKS MANAGER is REQUIRED for a Large Light Engineering Firm in the West London district. Applicants must be qualified Engineers with modern experience in Factory Management and Labour Control. The appointment is permanent and carries a good salary.—Write, Box 1223, White's, Ltd., 72, Fleet Street, London, E.C.4. 8310 A

SITUATIONS OPEN

OVERSEAS EMPLOYMENT. — APPLICA- TIONS are INVITED, from men under forty years of age, who are qualified to fill the undermentioned VACANCIES in the Near East:

ONE experienced SHIFT ENGINEER with experience of Steam Power Station Operation. Previous marine experience would be an advantage, but is not essential.

TWO PROCESS PLANT OPERATORS with experience in the Operation of Petroleum Refinery or other Plant, such as a Tar Distillery.

TWO MAINTENANCE ENGINEERS with previous experience in the Maintenance of Refinery and Chemical Works Equipment. Men with experience of Steam Plant preferred.

ONE ELECTRICIAN with technical training and practical experience of High-Tension Installations. A knowledge of High-Tension Cable Splicing would be an advantage.

Contracts will be for three years in the first instance and the starting salary is £600 per annum. A war allowance of £10 a month is given at present. Free passages and furnished accommodation.

Written applications (no interviews), giving full details of age, National and Armed Forces Registration Numbers, training, experience, and name of present employers, should be sent to the SECRETARY, Overseas Manpower Committee (Ref. 1082), Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2. 8348 A

SITUATIONS OPEN

ASSISTANT MANAGER REQUIRED for Small Engineering Works. Age about 40. First-class Engineer with Drawing-office experience. Knowledge of Piping Arrangements for Auxiliary Machinery and Heating Systems on board ships. Able to Estimate Costs. Good knowledge of Foundry Practice and Metal Alloys. Must be steady, of good appearance, and excellent character. Salary according to qualifications.

Applications, giving salary required, to APPOINTMENTS OFFICER, Appointments Office, Ministry of Labour and National Service, 38, Great North Road, Newcastle-upon-Tyne, 2. 8319 A

APPLICATIONS are INVITED by the NORTH OF SCOTLAND HYDRO - ELECTRIC BOARD for APPOINTMENT to the POST of SECRETARY to the Board. Applicants should have experience of Secretarial Duties and of Office Organisation and Management, and Legal Qualifications and Local Government experience are desirable.

Applications should be addressed to the ACTING SECRETARY to the BOARD, c/o SCOTTISH HOME DEPARTMENT, ST. ANDREW'S HOUSE, EDINBURGH. 8342 A

LARGE COMPANY in Midlands REQUIRES TECHNICAL MANAGER to Co-ordinate Technical Developments, Supervising Drawing-office, and Administrative Duties.—Address, 8317, The Engineer Office. 8317 A

MANAGER for Development Section in Large Company in Midland area. Excellent post-war prospects. Must have honours degree in electrical engineering and possess outstanding ingenuity.—Address, 8315, The Engineer Office. 8315 A

MANAGER for Maintenance Department RE- QUIRED for old-established Firm in Birmingham area. Must be capable of Supervising Plant Maintenance and Works employing over 3000.—Address, 8316, The Engineer Office. 8316 A

MANUFACTURERS of INDUSTRIAL PLANT REQUIRE well-educated MAN under 40 (exempt), to Train in London as Sales Engineer. Some engineering knowledge desirable, but not essential if adaptable and receptive. Excellent post-war prospects for keen man.—Write fully in confidence (no callers), stating age, experience, salary required, to "SALES DIRECTOR," The Pascall Engineering Co., Ltd., Monitor Works, 114, Lisson Grove, London, N.W.1. P6329 A

METALLURGICAL CHEMIST REQUIRED for Steel Analysis and Technical Control of Heat Treatment Dept. Good post-war prospects. Engineering works, Birmingham.—Address, 8333, The Engineer Office. 8333 A

MANUFACTURERS, Main Works Birming- ham, WISH to AUGMENT Existing TIME and MOTION STUDY STAFF. Knowledge of Chemical Processes and Chemical Engineering desirable.—Address, 8350, The Engineer Office. 8350 A

MECHANICAL ENGINEER REQUIRED for PERMANENT POST on work of national importance. Requirements: Excellent general and technical education, apprenticeship, and executive experience covering large-scale production. Salary £1000 p.a., with rapid advancement to suitable man. Applications, which are confidential, must include full details of qualifications, age, positions held, and salaries received.—Box 253, Strand House, London, W.C.2. 8291 A

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The Engineer

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Letters relating to the Advertisement and the Publishing Departments of the Paper are to be addressed to the Publisher; all other letters are to be addressed to the Editor of THE ENGINEER.

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Teleg. Address,
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Tel., Central 6565 (10 lines).

SITUATIONS OPEN

MANAGER REQUIRED for Planning Department of old-established Engineering Factory employing 1500 people, responsible for programme planning, shop loading and internal and external progressing. Situation has post-war prospects.—Address, giving full particulars and salary required, 8355, The Engineer Office. 8355 A

MECHANICAL and ELECTRICAL ENGINEER for the Gold Coast Government Public Works Department for two tours of 12 to 24 months, with possible permanency. Salary £475, rising to £840 a year. Separation allowance for married men is £80 on a salary of £475. Higher commencing salary may be offered to well-qualified candidate.

Free passages and quarters.

Candidates must be Associate Members of either the Institution of Electrical Engineers or the Institution of Mechanical Engineers, or hold an equivalent qualification, and, in addition, possess a thorough practical knowledge of Compression Ignition Oil Engines, Producer Gas Plant, and Suction Gas Engines, Pumping Plant, and A.C. and D.C. Electrical Generation and Distribution.

Write, stating age and full particulars of qualifications and experience, to MINISTRY OF LABOUR AND NATIONAL SERVICE, Central (Technical and Scientific) Register, "D" Section, D. 588X, Alexandra House, Kingsway, London, W.C.2. 8343 A

METALLURGIST WANTED for Ferrous Laboratory in West Midlands. Practical experience of Microphotography, Chemical Analysis, and Welding desirable. Write, giving full particulars of all previous training, qualifications, age, and when at liberty. Salary about £450 p.a.—Address, 8328, The Engineer Office. 8328 A

PROGRESS MANAGER to Control Stores, Works Progress, and Loading, for factory in West of England producing engineering product for Air Ministry. Shop training essential. Age 35-40.—Address, stating salary, experience, &c., 8306, The Engineer Office. 8306 A

SPECIALISED SCIENTIFIC INSTRUMENT MANUFACTURERS have a VACANCY for a PRODUCTION ENGINEERING MANAGER to Take Charge of the following departments:—Methods Engineering, Process Planning, Jig and Tool Designing, Rate Fixing, Production Planning, Scheduling, Machine Loading and Progress. Only candidates with a sound knowledge of modern production engineering methods and control will be considered. The post is a permanent one and is eligible for participation in a bonus scheme.—Write, Box 1215, White's, Ltd., 72, Fleet Street, London, E.C.4. 8309 A

THE Post You Are Seeking May Not Be Advertised in this Column, but do not lose the Opportunity of Bringing your Requirements before all those who would be interested and could employ you. An Advertisement in the "Situations Wanted" Column would be seen by all Leading Engineering Concerns for the cost of Four Lines, 6s.; 1s. 6d. for each Additional Line. There is no better way of covering so large a field for such a small charge.

TOOL ROOM HEAD FOREMAN REQUIRED, to Take Charge of Shop primarily engaged in Manufacture and Maintenance of Press Tools and Specialised Machines under Essential Works Order. Good post-war prospects, previous experience essential, age not under 30.—Write, Box B.L. 2, c/o 5, New Bridge Street, London, E.C.4. 8352 A

WELL-KNOWN MIDLAND FIRM, Engaged in the Manufacture of Sheet Steel Products, including Office Equipment, WISH to APPOINT a DEPARTMENTAL MANAGER who can Take Charge of Designs, Estimating, and Production Planning and Act as Liaison between Drawing-office and Works. Applicants must have had wide experience in the Sheet Steel Product Industry. Give full details of previous training and experience, also age.—Address, 8351, The Engineer Office. 8351 A

WORKS MANAGER REQUIRED. Having requisite experience, drive and organising ability to carry out programme in Aircraft Repair Works with 1000 employees.—Applications to Box 225, Reynells, 44, Chancery Lane, W.C.2. 9346 A

SITUATIONS OPEN

DRAUGHTSMAN (About 30) for the Supervision of the Production of Filtering Media (Processed Clinker), Air Ministry Work; £1040 to commence. Must be resident now in the Metropolitan Area and be in receipt of £780.—State details of present duties only to HIBBERTS, Ltd., Valiant Works, Vicarage Crescent, Battersea, S.W.11. Mark on the envelope top left-hand corner "D.O." It is particularly requested that applicants who do not fulfil all the conditions will not apply. 9716 A

SITUATIONS WANTED

ADMINISTRATIVE APPOINTMENT DESIRED (London district). Excellent commercial and engineering ability, 15 years' experience with one firm as general manager, co-ordinating all depts., including design, production control, sales, accounts, &c., in light general engineering concern employing approx. 1300; used to controlling executive staff and taking full responsibility.—Address, P6319, The Engineer Office. P6319 B

CAMBRIDGE GRADUATE, Liberal Works engineering experience, SEEKS ASSIST. POST of more managerial nature.—Address, P6333, The Engineer Office. P6333 B

CHARTERED ELECTRICAL ENGINEER (34), with civil and hydro-electric experience, DESIRES CHANGE, preferably South of England or to work involving foreign travel. Wide administrative and executive experience in public electricity supply and of general construction work. Well practised in preparation of official reports and estimates, and in survey and laying out of engineering schemes. French, Spanish, F.R.S.A. Would be prepared to consider Partnership with Consultant.—Address, P6327, The Engineer Office. P6327 B

DESIGNER - DRAUGHTSMAN (25) SEEKS POST, Radio or Electrical Research Establishment, South London preferred. Good inventive capabilities, Assoc. Brit. I.R.E., A. Inst. Patentees. Release obtainable.—Address, P6324, The Engineer Office. P6324 B

ENGINEER REQUIRES EXECUTIVE POSITION. Many years' experience technical and practical or design, production, planning, tooling-up, estimating, &c. Interested in precision engineering, machine tools, motor and allied trades.—Address, P6292, The Engineer Office. P6292 B

ENGINEER, Age 32, Higher National Certificate, Mech. Eng. and Endorsement, experience plant and motor vehicle maintenance, DESIRES POSITION as Assistant Engineer where facilities exist for acquiring additional technical education. Salary secondary consideration to suitable position where progressive advancement may be expected on proven ability.—Address, P6326, The Engineer Office. P6326 B

ENGINEER (42), B.Sc., A.M.I.E.E., Just Completing work of national importance, SEEKS RESPONSIBLE POSITION affording good post-war prospects. Experienced planning, organising, installation, maintenance, machinery, power, sound equipment, and company management. Birmingham or London area preferred.—Address, P6330, The Engineer Office. P6330 B

ENGINEER EXECUTIVE (44), Free 30th September, exp. as works manager, chief engineer, gen. manager, marine, chem. plant, I.C. erect., maint., production, planning, drawing-office, sales and office organisation.—Address, 8356, The Engineer Office. 8356 B

EXECUTIVE of Wide Experience in the Engineering industry will be free towards end September to accept ADMINISTRATIVE POSITION where his experience may be used to further the war effort and post-war development. Experience embraces sales management, overseas development, works reorganisation, production control, group production co-ordination, and general administration as managing director. May be of interest to directors wishing to co-ordinate the productive effort of a group of factories.—Address, P6323, The Engineer Office. P6323 B

G.I. MECH. E. (24), At Present Engaged on experimental oil engine design, DESIRES CHANGE, experimental and development work preferred, but other offers may be acceptable.—Address, P6322, The Engineer Office. P6322 B

IF the Man You Are Seeking is Not Amongst those Advertising in this Column, a Small Announcement in the "Situations Open" Column will Quickly and Economically Produce the Right Selection of Applicants, at the same time Eliminating Waste of Effort, Waste of Time, and Waste of Opportunity. The charge is Four Lines or under, 6s.; each Additional Line, 1s. 6d. Box Numbers, 1s. extra, which includes despatch of all replies.

JIG and TOOL DRAUGHTSMAN (40) SEEKS CHANGE as Draughtsman Supervision or Planning; 15 years' practical toolmaking and 3 years as designer. Prefer London area. Release obtainable.—Address, P6331, The Engineer Office. P6331 B

MECHANICAL and ELECTRICAL ENGINEER (45), at present chief engineer to a group of textile mills, DESIRES CHANGE, preferably to heavy engineering. Nat. Certif., First Class C. and G. Elec. Certif. Min. sal. £750 p.a.—Address, P6325, The Engineer Office. P6325 B

PRODUCTION ENGINEER (30) SEEKS CHANGE to position offering wider scope, London or South. Practical and technical man, with experience of all branches of production and investigation of works problems.—Address, P6328, The Engineer Office. P6328 B

SITUATIONS WANTED

PROCESS and PRODUCTION ENGINEER DESIRES EXECUTIVE POSITION; 14 years' American experience in the development of efficient manufacturing processes, also extensive British experience. Industries served include communications equipment and electric cable manufacture, small arms ammunition, automobile electrical equipment, including batteries, locomotive maintenance, and jam making. Age 42.—Address, P6332, The Engineer Office. P6332 B

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WANTED, ROLLER FLATTENING MACHINE for flattening steel plates up to 8ft. wide by ¼in. thick. Either self-contained or belt-driven. If self-contained, to be suitable for operation from power supply of 400 volts, three-phase, 50 cycles. Licence No. 151. Particulars.—Address, 8344, The Engineer Office. 8344 F

WANTED, AIR COMPRESSOR, Vertical intercooled two-stage, 80/100 cu. ft. free air per min., 120 lb. per sq. in., 400-v., 3-phase, 50-cycle motor and starter. Mobile type or will consider stationary unit.—C.S., Ltd., Staffa Works, Staffa Road, Leyton, E.10. 8353 F

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PATENTS

THE OWNERS of PATENTS No. 46... "Improvements in or relating to ... and No. 506,599, for "Improvements ... Operating Mechanisms for Adjustable ... Operating Tables, and the like," WISH to ... all DEMANDS for the UTILISATION ... and invite inquiries from parties ... assist in commercially exploiting the ... Address in first instance Messrs. ... POLLAK, MERCER, TENCH and ... Chartered Patent Agents, 20-23, ... London, E.C.1.

THE OWNERS of PATENTS Nos. ... 465,462, and 465,501 WISH to ... DEMANDS for the UTILISATION ... invite inquiries from parties competent to ... in commercially exploiting the same. The ... tions refer to various improvements in ... apparatus and equipment designed to ... efficiency and convenience of operation ... respecting both operator and patient.—... first instance Messrs. DICKER, POL... MERCER, TENCH and MEYER, ... Patent Agents, 20-23, Holborn, London, ...

THE PROPRIETOR of BRITISH P... No. 522,813, relating to "Door ... Means," is DESIROUS of ENTERING ... ARRANGEMENTS by way of LICENCE ... otherwise on reasonable terms for the pur... EXPLOITING the same and ensuring ... development and practical working in ... country.—Interested parties who desire ... of the patent specification and further par... should apply to ARTHUR W. PARIT... Stafford House, Norfolk Street, London, ...

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For continuation of Small Adver... ments see page 56

A Seven-Day Journal

Faster Standard Cargo Ships

IN describing some of the more recent developments in British shipbuilding and marine engineering in our issues of May 7th and May 14th, we made mention of the impending construction of several further faster standard cargo ships propelled by geared turbine or oil engine machinery. The first of these ships, we are able to state, is now approaching completion at a shipyard on the North-East Coast, and the construction programme is such that others will rapidly follow. The ships have a deadweight carrying capacity of 12,000 tons, and although they were designed two years ago they are an answer to the demand for faster cargo ships. The hull is riveted, but welded construction is freely employed on bulkheads and interior parts of the hull and on deck houses. Features of the design include larger cargo holds and hatches, which are served by high-power electric winches, with special derricks, enabling heavy loads to be quickly and conveniently handled. In addition, provision has been made for extensive deck cargoes, while the 'tween deck spaces are particularly good. The accommodation for the officers and the crew is carried out in accordance with the high standard which is now being adopted for all our new ships. Provision is made to carry a limited number of passengers, who are accommodated in roomy and well-furnished cabins. In the ship to which we refer the propelling machinery comprises a twin-screw arrangement of standard geared turbines taking steam from a pair of Foster Wheeler water-tube oil-fired boilers. Particulars of this machinery and illustrations of it under construction will be found in our issue of May 14th. A feature of the machinery lay-out is the placing of the engines and the boilers in one engine-room, which is much smaller in size than that adopted with early machinery of similar design. An auxiliary boiler serves the domestic and heating services and most of the auxiliary engine-room and deck machinery is electrically operated, the necessary current being obtained from three six-cylinder oil engine driven generating sets. The main boiler steam pressure is about 450 lb. per square inch, with a superheated steam temperature of 750 deg. Fah. Under working conditions a boiler efficiency of about 87 per cent. has been attained.

The Technical Training of Engineering Apprentices

IN our last issue we published a memorandum on the technical training of engineering apprentices, which was originally prepared by the Manchester District Committee of the Amalgamated Engineering Union. On Saturday, September 18th, a conference was held in Manchester to discuss this memorandum, and was attended by over forty representatives of various bodies interested in technical education. The meeting was presided over by Alderman Wright Robinson, the Deputy Lord Mayor of Manchester, and among those present were representatives from Manchester University, the Technical Colleges of Manchester and District, the Director of Education for Manchester, Lancashire Education Committee, Manchester District Engineering Employers' Federation, the Engineering Trade Unions, the Association of Scientific Workers, and two firms which have taken special interest in the training of engineering apprentices, Mather and Platt, Ltd., and the Renold and Coventry Chain Company, Ltd. The discussion centred mainly around the weaknesses in existing facilities for training, and it was admitted that evening classes were not satisfactory. Many colleges, it was stated, were ill-equipped and staffed for training in crafts. The suggestion in the memorandum that training should, if necessary, be separated from industry caused much discussion, especially as regards the cost of such a plan. Particulars of an alternative scheme of apprentice schools and a separate training section in the works were given. Some strong comments were made on the number of students who failed to complete their studies for the National Certificate owing, it was stated, largely because of the lack of prospects. The difficulty of training students who were engaged on work with payment by results was raised. With an anxiety to increase earnings, training, it was found, invariably suffered. After a most useful discussion the following resolution was unanimously adopted: "That, having discussed the memorandum as submitted by the unions, it is agreed that considerable changes are necessary in the training of engineering apprentices. It is further agreed that a more uniform policy on training is necessary, rather than leave the subject to the initiative of progressive firms, on the one hand, or the indifference of many, on the other. A uniform policy means a national policy, and it is agreed that the subject should be pursued on such lines. It is finally agreed that the changes suggested in the memorandum can be accepted for further discussion by the bodies represented at the conference without binding them to approval. The object will have been attained if the fullest possible discussion is given to them."

"Victory" Ships

IN a speech given in London on Friday, September 17th, Rear-Admiral Howard L. Vickery, of the United States Navy, said that the war could not be lost by the United Nations through lack of shipping. To-day the maximum shipbuilding production had been reached, which was now between 1,700,000 and 1,750,000 tons deadweight a month. That was likely to be the average, although a figure of 1,790,000 tons had been reached and it might attain 1,800,000 tons. The position had now been reached when, in order to use materials in the best way and to increase carrying capacity, faster types of ships were being built. At the North Carolina yard the last "Liberty" ships had been completed and production was being changed to faster vessels. This would also take place at the shipyards at Oregon and in California. The keel of the first "Victory" ship is to be laid at the end of November, and she will be launched about the middle of January. The "Victory" ship is rather longer than the "Liberty" ship, with a larger beam and draught and an extra hold. The first of these faster ships will be equipped with engines of extra large power, designed to give a loaded speed of 17½ knots. In general, the speed of other "Victory" ships will be about 16 knots, compared with the 11 knots for the "Liberty" ships. When the programme is in full swing the production of "Victory" ships will rival the output of "Liberty" ships. Contracts have already been placed for the delivery of 1000 faster ships by the end of 1944, many of which will be of the "C" type and some of them tankers. The original estimated building time for the "Liberty" ships was 513,000 man-hours, and this has been gradually reduced to 200,000 man-hours. The estimate for the "Victory" ships was 600,000 man-hours, but no doubt this time would be reduced in some yards.

The Late Mr. William Hay Howden

THE death of Mr. William Hay Howden, which took place suddenly on Saturday, September 11th, at his home, Clippens House, Johnstone, Renfrewshire, severed another link with the history of marine engineering progress on the Clyde. He was the son of the late James Howden, the founder of James Howden and Co., Ltd., and became a director of the firm in 1907, at the time it was made into a limited liability company. He was also a director of James Howden and Co. (Land), Ltd., and of the British Arc Welding Company (Scotland), Ltd. William Howden received his education at Kelvinside Academy, Loretto School, and Glasgow University. On completing his educational course he entered his father's works and served his apprenticeship in the Scotland Street works. From an early age he took a keen interest in the management of the company and the development of its many-sided interests connected with combustion engineering for marine and land uses. He was specially interested in the labour side of the industry he so well served, and was a Vice President of the North-West Engineering Employers' Association and Chairman of the Glasgow District Committee of the Foremen and Staff Mutual Benefit Society (Engineering Shipbuilding and Allied Trades). He was a member of the Institute of Naval Architects, and at the spring meetings of 1931 he read an interesting paper on "Some Modern Examples of Air Heaters." He was a member of the Institution of Engineers and Shipbuilders in Scotland, and the North-East Coast Institution of Engineers and Shipbuilders. Apart from his business interests, Mr. Howden found time to support many other activities concerned with Glasgow and the Clyde. He was interested in the Trades House of Glasgow, and was a former Deacon of the Incorporation of Hammermen. He was a Member of Council of the Royal Glasgow Institute of Fine Arts and was a justice of the peace of Glasgow. In 1940 Mr. Howden was appointed Chairman of the West of Scotland Committee, which was established by the Ministry of Labour and National Service in order to ensure the disposal to the best advantage of all the available skilled workers and the provision of additional labour force by the training of semi-skilled workers. When in 1941 the Man Power Boards were formed, Mr. Howden was appointed to the Glasgow District Man Power Board as its Deferment Officer.

Scientific Information

AT a conference arranged by the Association of Special Libraries and Information Bureaux, which took place at Burlington House last week-end, Mr. J. G. Crowther, Director of the Scientific Department of the British Council, gave an address on "Scientific Information." He said that Britain could have no future as a first-class Power unless she modernised her scientific and technical resources and unless she made herself the focus of a closely knit Commonwealth. In a recent interview in the United States, Sir John Anderson had referred to discussions on the formation of a British Commonwealth Scientific Office, with which the United States and other nations might collaborate. The formation of a British Scientific Information Service would form part of such a scheme and would perhaps form part of a World Information Service.

"Training Within Industry"

IN view of the growing stringency in the supply of labour for the munitions and other industries, it is necessary for employers to pay the closest attention to the efficient utilisation of labour. In particular, quicker and more effective measures for training new entrants than those which often served in peacetime are now required. Practically all new recruits, even those to be employed on relatively unskilled work, will benefit from systematic training instead of being left to "pick up" the job by trial and error methods. Inadequate training of new workpeople is frequently responsible for excessive labour turnover, injuries to workpeople, damage to plant, excessive production of scrap, and low production per head. The Minister of Labour and National Service therefore wishes to call the attention of employers to the need for reviewing the arrangements for training in their factories and for taking steps, where necessary, to improve them. In order to assist employers in setting up and developing such arrangements, the Ministry of Labour and National Service, which has trained over a quarter of a million men and women at Government Training Centres for the engineering industry alone, has made available special facilities which are outlined in a leaflet (P.L. 125, 1943), copies of which can be obtained from any local office of the Ministry. The facilities available include the supply to employers of a manual (P.L. 128, 1943) dealing with the best methods of training new staff for production work. Employers wishing to avail themselves of these facilities should get into touch with the local Employment Exchange or the District Manpower Office.

Historic Accidents and Disasters

No. XX*

THE LAUNCH OF THE "DAPHNE"—No. I

SUCCESS in the launching of a ship depends upon many factors, all of which are not fully amenable to human control. If everything goes well only a few minutes should elapse between the knocking away of the dog shores and the instant at which the ship, fully waterborne, comes under the command of the attendant tugs. The possibility of mishap is, however, always present during these anxious seconds. The ship may refuse to start down the ways, or, having moved a little, may pull up and remain in a perilous condition between land and water. If this mishap is escaped, others lie in wait. At one stage of the ship's progress into the water her stern will be afloat while her bow is still on the ways. Supported in this manner, there is a momentary danger that the ship will severely strain her structure or even break her back. Again, the cradles helping to keep her upright as she moves down the ways may collapse or even catch fire; the drags provided for checking her momentum just after she is waterborne may be inadequate or act perversely; or, for one reason or another, the ship may lurch or roll as she leaves the ways and may capsize or at least acquire a dangerous list.

In 1637 the "Sovereign of the Seas," built by Peter Pett at Woolwich, refused to move at the height of the September spring tide. A month later an unusually high tide occurred and the ship unexpectedly launched herself and narrowly escaped disaster before she was brought under control. This and similar mishaps led to the practice of building large ships in dry docks in order that when completed they might be floated without incurring the risks attending a normal launch. This practice is even yet not wholly extinct.

In 1861 H.M.S. "Northumberland" was laid down at Millwall. She was on the stocks for five years, and when the time at last came to launch her she refused to move until the tide was ebbing. Then suddenly she started down the ways, but only to stick again halfway into the water. For a month she remained in that condition with her stern waterborne and in imminent danger of breaking her back or falling over on her side. At the next spring tide she lifted herself clear and slid into the water with such high speed that she was checked only just in time to prevent her crashing into the opposite bank of the river.

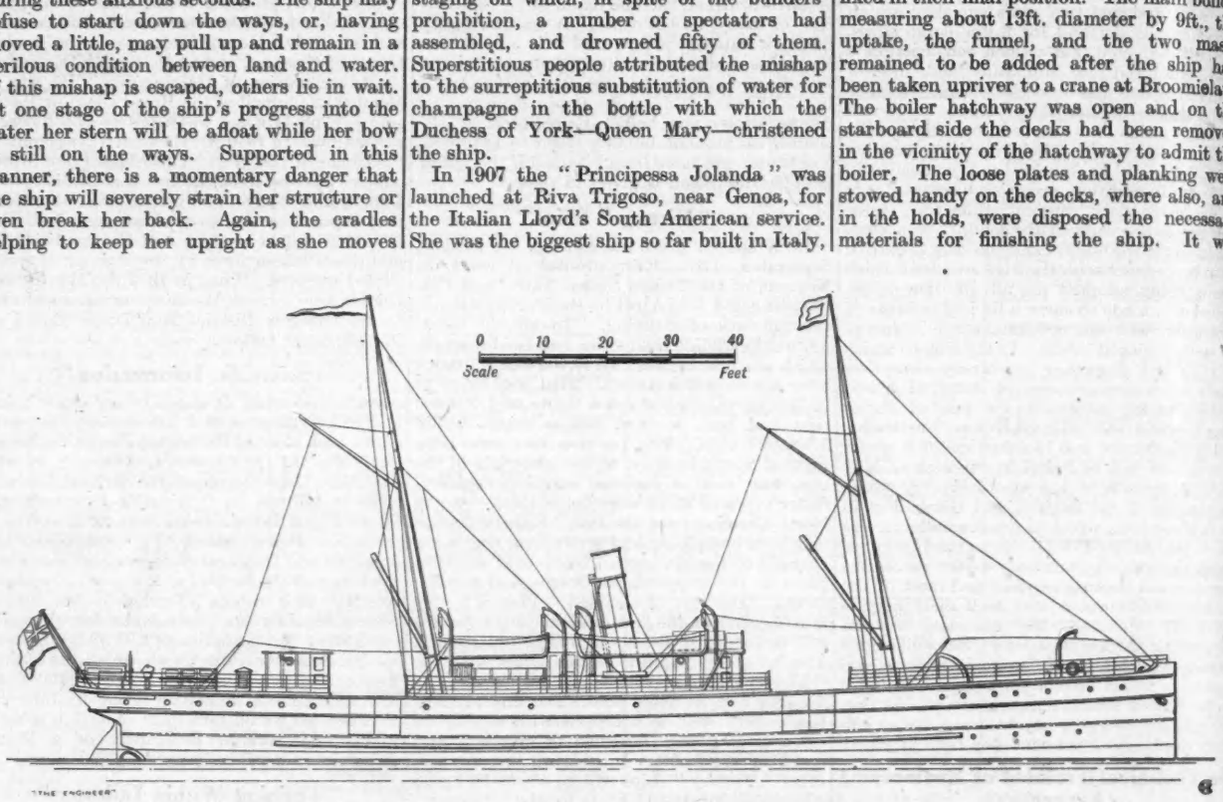
A mishap of a different kind happened at Blackwall in 1896, when H.M.S. "Albion" was launched from the Thames Ironworks Company's yard. The launch itself was successful, but the backwash swept away a staging on which, in spite of the builders' prohibition, a number of spectators had assembled, and drowned fifty of them. Superstitious people attributed the mishap to the surreptitious substitution of water for champagne in the bottle with which the Duchess of York—Queen Mary—christened the ship.

In 1907 the "Principessa Jolanda" was launched at Riva Trigoso, near Genoa, for the Italian Lloyd's South American service. She was the biggest ship so far built in Italy, and to make the occasion the more impressive it was decided that she should take the water with all her machinery in position and ready for steaming. As the ship went down the ways the port side cradle caught fire and broke away. The liner entered the water with a heavy list and began to fill through openings in her side. Within twenty minutes she capsized. Of the unduly large number of people on her, all were saved, but a spell of bad weather followed, the ship settled down in the sand, and after a large part of the machinery had been recovered, the wreck was dispersed by means of explosives.

The tragic mishap which overtook the "Daphne" at her launching on the Clyde on July 3rd, 1883, is of outstanding historical and technical interest. Up to that date shipbuilders everywhere had followed a simple rule-of-thumb method of determining the safety of a ship against capsizing during the short critical launching period. The disaster to the "Daphne" drew forcible attention to the fact that the rule-of-thumb procedure was unscientific and dangerously inadequate.

The "Daphne" was built at Linthouse by Alexander Stephen and Sons for the Glasgow and Londonderry Steam Packet Company, of which Alexander A. Laird and Co. were the managing owners. She was a small iron screw steamer with a certain amount of passenger accommodation, but primarily intended for the Irish cattle trade. She had a gross register tonnage of about 460, and a net register tonnage of about 200. Her length between perpendiculars was 176ft. 3in., her extreme breadth 25ft. 2in., and her depth of hold 13ft. 3½in. Her compound engines were of 120 nominal horsepower. We take these figures from the evidence given by Mr. Alexander Stephen at the Home Office inquiry into the disaster, conducted by Sir Edward Reed.

At the time of the launch the engines, shafting, propeller, donkey boiler, donkey engine, cattle stalls, and horse boxes were fixed in their final position. The main boiler, measuring about 13ft. diameter by 9ft., the uptake, the funnel, and the two masts remained to be added after the ship had been taken upriver to a crane at Broomielaw. The boiler hatchway was open and on the starboard side the decks had been removed in the vicinity of the hatchway to admit the boiler. The loose plates and planking were stowed handy on the decks, where also, and in the holds, were disposed the necessary materials for finishing the ship. It was anticipated that she would be completed within ten days after her launch.



THE LAIRD LINE STEAMER "DAPHNE"

The launch took place at about 11.25 a.m., half an hour or so before high water at Glasgow and ten minutes before high water at Linthouse. The weather was calm and fine. The ship went down the ways in all respects normally, and when her bow was about 37ft. clear of the ways the drags came into action to check her motion. There is a little uncertainty as to what happened about this time. We follow the account given by Mr. John Stephen, an eye-witness. Mr. Stephen asserted that the ship was first checked by the drag on the starboard side, shortly before the port side drag came into action. As her bow cleared the ways she listed slightly to port, but recovered herself when the drags became effective. Thereafter she inclined to port again, recovered, went slightly over to starboard, and then finally rolled over to port. The roll continued until the gunwales went under the water, and the ship capsized. Before capsizing and settling down, she drifted upstream by about 85ft. at the stern and 30ft. at the bow.

The police recovered 124 bodies from the interior of the ship and from the river, and collected the names of 71 men and boys who were on board and survived. It is possible

* No. XIX appeared January 29th, 1943.

that there were other victims and other survivors, for it seems that there was little to prevent anyone, worker or stranger, from gaining access to the ship for the purpose of partaking in her launch. The total number of those on board at the time—some 200—was unduly large for such a small ship. It was, in part, explained by the fact that some of the shipyard workers detailed to complete the ship at Broomielaw proposed to make the trip upriver in her immediately after the launch.

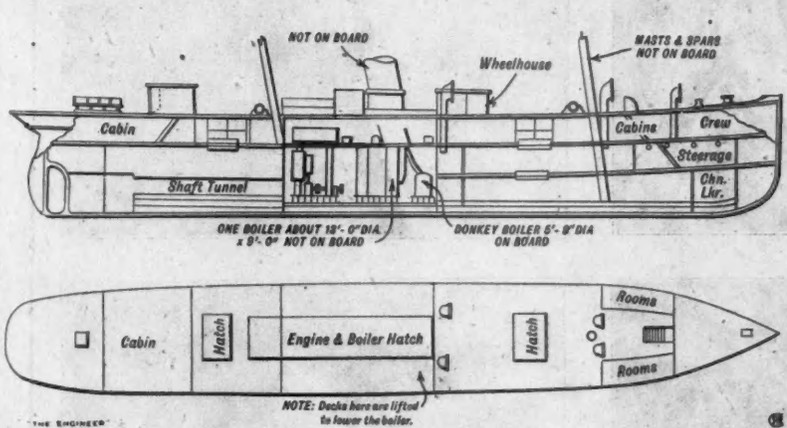
The disaster aroused widespread attention among naval architects and shipbuilders. The upsetting fact which had to be faced was that a ship, which, according to the established traditional rule, should have been perfectly safe to launch, had shown herself to be so deficient in stability that she had capsized within a few seconds after clearing the ways.

At the official inquiry, presided over by Sir Edward Reed, the builders were represented by Professor Roberton, and also by Mr. Francis Elgar, at that time a consulting naval architect in London. Mr. Elgar was engaged by Messrs. Stephen to make a private investigation into the cause of the accident, and freely placed his conclusions at Sir Edward's disposal. The partners in the firm of Messrs. Stephen, members of their staff, a number of the Linthouse yard workers, and representatives of the ship's owners were closely examined. In addition, evidence or testimony was submitted by several well-known shipbuilders, including Mr. William Pearce, Mr. Robert Mansel, Mr. Peter Denny, Mr. J. H. Biles, and Monsieur Benjamin Normand, of Havre. Sir Edward Reed's personality, however, dominated the whole of the inquiry. From the outset he seems to have had his mind made up concerning the cause of the disaster, to have listened attentively to any testimony which supported or might be made to support his preconceived opinion, and to have rejected arbitrarily and almost curtly any views not in harmony with it. To the historian his report is an unsatisfying document. It advances a theory, the general truth of which cannot be disputed, but it omits certain vital data required to prove that the theory was fully applicable to the particular case of the "Daphne." We are fortunate in being able to repair some of the omissions. Messrs. Stephen have, with great courtesy, placed at our disposal the contemporary drawings of the ship, reproduced herewith, and have furnished us with a few additional particulars which partially fill in the blanks in Sir Edward's report.

Evidence taken at the start of the inquiry satisfied Sir Edward that the disaster was in no material respect attributable to any defect in the launching ways. There was some discussion as to the possible influence of the drags upon it. The fact was noted that the drags were not attached to the hull in precisely the same manner or at the same level on both sides of the ship, and that one became operative before the other. It was, however, clearly established that the ship was well off the ways before she showed signs of capsizing, and that fact seems to have been sufficient to convince Sir Edward that the launch was normal, so far as the ways and drags were concerned.

Information was sought as to the condition of the cattle-ports—two on each side—and the portholes at the time of the launch. Workmen specially detailed to attend to them were emphatic in declaring that they were all closed, and no other witness contradicted them. As already stated, however, the boiler hatchway was open. It is therefore certain that after a considerable heel had been reached—something in excess of 50 deg. —water would find its way into the ship's interior. The removal of the deck plates could have added little to the gravity of the inflow because the plates removed were on the starboard side, whereas the ship's fatal lurch was to port.

Three experienced Clyde shipbuilders—Mr. McMaster, yard manager at Linthouse; Mr. Pearce, of John Elder and Co.; and Mr. Mansel, who owned a yard on the opposite side of the river, about 300 yards below Messrs. Stephen's—declared that in their view the "Daphne" just as she became fully waterborne was "tripped by the tide." At or near high tide, they said, there was a strong upward surface current in the river, accompanied by another of considerable velocity downstream below the surface. Mr. Mansel stated that he had been aware of the influence of these contrary currents on the launching of ships on the Clyde since the year 1854, when the "Lancefield" built at Napier's yard nearly capsized at her launching as a result, in his opinion, of their action. He also stated that, following the opening of the Queen's Dock, both the currents had become more pronounced. In this connection it should be noted that Linthouse is on the left bank of the river, so that the lurching of the "Daphne" to port is in consonance with the supposition that an upstream surface current was acting on the starboard side of her hull near the water line and a downstream sub-surface current on the port side in the neighbourhood of the keel. It follows that, according to this theory, a ship launched from a yard on the right bank of the river at or near high tide should lurch to starboard.

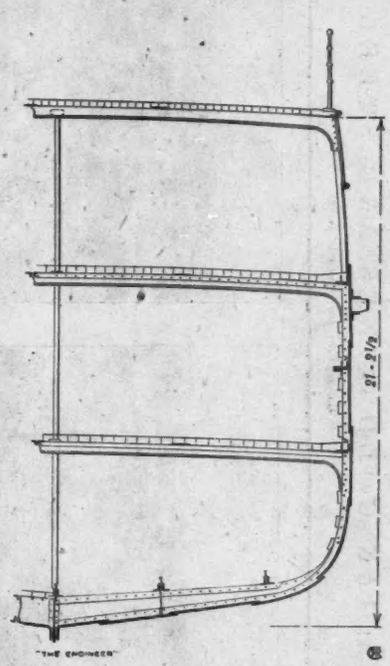


SECTION AND PLAN OF THE "DAPHNE"

Less than a year before the mishap to the "Daphne," J. and G. Thomson launched the "Hammonia" from their yard at Clyde bank, on the right of the river. Immediately on taking the water she heeled to starboard, returned by about 10 deg. towards the vertical, rolled to starboard, lifted again, and finally heeled over to starboard to an angle of 40 deg. or 50 deg., where she remained. In this listed condition she was towed into dock, where she gradually settled down on her side as a result of the ingress of water through a few holes in her hull.

Full details of this earlier mishap were laid before Sir Edward Reed during his inquiry into the cause of the disaster to the "Daphne." The remarkable similarity between the motions of the two ships up to the instant of the final heel will be noticed, while the fact that the one ship lurched to starboard while the other capsized to port is, in view of the opposed situation of the two yards, in full agreement with the "counter-current" theory.

There is nothing to show that this agreement made any impression on Sir Edward's mind or even that he recognised its existence. He did not, as he might readily have done, take any practical step to prove or disprove for himself the existence of the two alleged currents. Instead, he accepted the testimony of Mr. Deas, the engineer to the Clyde Trust, who asserted that the Clyde was really a sluggish river, and that all his observations showed there was no contrary current below the surface.



MIDSHIP CROSS SECTION

Whatever opinion may be held concerning the merits of the counter-current theory, many readers will no doubt feel, as we do, that in dismissing it in this way Sir Edward acted in a manner which was somewhat injudicial and certainly unscientific. We find ourselves unable to avoid the conclusion that his attitude towards the theory was determined by his desire to use the case of the "Hammonia" as an additional example supporting his own opinion of the cause of the mishap to the "Daphne." As we shall see presently, he did so make use of it to the fullest possible extent.

Years afterwards, in a paper which he read before the Institution of Naval Archi-

AUSTRALIAN GOLD MINES AND STEEL WORKS

(For description see opposite page)

STEEL WORKS, NEWCASTLE, NEW SOUTH WALES

BROKEN HILL STEELWORKS, NEWCASTLE, NEW SOUTH WALES

GREAT BOULDER MINE, KALGOORLIE, WESTERN AUSTRALIA

GOLD MINE, BOULDER, WESTERN AUSTRALIA

tests in 1897, Sir Edward characterised the disasters to H.M.S. "Captain" and the "Daphne" as the two principal occurrences which had led to the development and general application of modern ship stability theory. To-day we feel that the "Daphne" comes into the picture only because Sir Edward forced her into it, using the "Hammonia" as a lever.

(To be continued)

Engineers and the British Empire

By Professor MIDDLETON SMITH, M.Sc., M.I. Mech. E., LL.D.

No. XII—*(Continued from page 221, September 17th)*

Australian Natural Resources

COAL is one of the few staple raw materials so essential for modern industry that a country without access to it in abundance cannot hope to manufacture cheaply. Although water power is valuable for mechanisation, coal is essential for the heavy industries, and in recent years it has become of great value for the extraction of certain chemicals.

There is relatively little water power available on the continent, but no single country in the Southern Hemisphere is endowed with greater coal resources than Australia. The combined deposits of New Zealand, the rest of Oceania, Africa, and South America do not reach the magnitude of those of Australia. An eminent Australian geologist states that a round figure of 70,000 million tons of coal is available for economic estimates. Three-quarters of the total reserves lie within the borders of New South Wales, which is predominantly the black coal producing state; it produces over 80 per cent. of the whole output of Australia and supplies all the other states. The largest collieries have had daily outputs exceeding 2000 tons. The most productive district is near Newcastle. The southern district collieries are about 50 miles by rail from Sydney. Queensland comes second in production with only 8 per cent. of the national output. Victoria ranks third. There are deposits in all the states.

In Victoria the state has utilised the brown coal found there for the Morwell electric generating station. In the Latrobe Valley, within a hundred miles of Melbourne, is the largest single deposit of brown coal in the world. It is believed to occupy an area of 600 square miles, of which 150 square miles have been proved to contain coal.

The railways consume a great deal of coal, as do the electric light and power plants of the country. But in New South Wales almost twice as much is used by engineering, iron and steel works, and the associated coke plants, as is consumed by railways and electricity plants.

It is estimated that the 106 gasworks in Australia use about 10 per cent. of the total coal consumed in the country. Owing to the temperate climate enjoyed by the mass of the town dwellers, the market for household coal is comparatively small. It is particularly noticeable that there has been a great increase in the horsepower of engines installed and also a considerable economy in coal consumption per horsepower. As in other countries, there has also been a great increase in the use of oil and electrical power.

There is a considerable coal export trade; before the war New Zealand provided the best market. The Dutch East Indies, the Philippines, Malaya, Japan, and China were also markets; most of the coal exported was used for ships' boilers and industrial plants.

No black coal has been discovered in the Northern Territory, but some tertiary lignite has been found.

Reference should be made to the near-coal, or cannels, known as "kerosene shale," &c. They are found in Tasmania and in a district 88 miles west of Sydney and in New South Wales. In the latter state it is estimated that 40 million tons are available, containing 3500 million gallons of crude oil.

The totals of actual reserve and probable reserve in coal in Australia, estimated by an International Congress, are as follows in millions of tons, viz.:—Black coal, 2070 and 130,839; lignites, 219 and 32,414. Australian estimates exceed those figures, which are high enough to encourage industrial development in the continent on a large scale. The industrial development of the Far East will offer an enormous potential market for coal, not only for steam raising, but especially for metallurgical industries.

As in other industries, the high wages common in Australia have increased the cost of production. Yet in 1913 the coal of New South Wales was among the cheapest in the world, but there have been increases in prices of the mineral since that date all over the world. The cost of production in the years before the war was considerably less than in Great Britain, but from 1923 onwards, for some years, coal prices in New South Wales (the exporting state) and Britain moved in opposite directions, rising in the state and falling in Britain. Thus, in 1931 pithead coal per ton in New South Wales cost 17s. 6d., in Britain 12s. 10d., in the Ruhr 14s. 8d., and in Natal 7s. 6d.

Winning the Brown Coal

As far back as 1866 brown coal analyses were made in Victoria and since that date much attention has been given to its utilisation. With moisture content of (1) 60 per cent., (2) 10 per cent., (3) nil, the calorific values in B.Th.U. per pound are (1) 4700, (2) 10,570, (3) 11,750. In one square mile to the south of the site of the Morwell power station borings showed deposits of 150 million tons. It is stated that 150 million tons is sufficient to supply fuel for a 150,000-kW station for 100 years.

The overburden—material covering the coal—averaged about 28ft. in thickness and consisted of sand, sandy class, and clay, which had to be removed by steam and electric shovels.

The opening up of the coalfield at Yallourn (Morwell) involved the removal of more than one million cubic yards of overburden. The term "open cut" is used for this field, because when the overburden is removed the coal is worked as an open face. The open cut is 600ft. wide from north to south and well over 2000ft. long. The removal of the overburden involves three main operations—excavation, transport, and dumping. A considerable amount and variety of machinery, such as steam shovels, electric shovels, conveyors, locomotives, &c., is employed in this work.

Briquetting

Inquiries were made as far back as 1891 concerning the mining of brown coal in Germany, and particularly the making of brown coal briquettes. It was not until 1917 that the manufacture of briquettes was begun. The process consists in crushing, screening, drying, cooling, and moulding, under a high pressure, the dried powdered coal to form the briquette. About 90 per cent. of the water in the raw coal is removed before the coal reaches the presses. The briquettes produced are 10in. long and about 2¼in. deep and 1¼in. to 2in. thick; they are indented so as to break readily into two pieces, for domestic use, and four pieces for industrial use.

The coal is taken to the wet preparation house, which reduces the coal to a maximum size of about one-fifth of an inch diameter, and returns the woody portions, and any further coal required for steam-raising purposes, to the boiler-house by belt conveyor. The fine coal is carried by a belt conveyor to storage bins above driers, where it passes through tubes and is steam heated by exhaust steam from the presses and a turbo-generator. The coal is then conveyed by enclosed worm conveyors to the cooling plant, where it is thoroughly mixed, cooled by exposure to the air, and then conveyed to the press-house. Each press consumes about 150 H.P. and produces 80 to 90 tons of briquettes each day. The initial plant yielded about 350 tons per day and the scheme was designed for an output, after extensions, of about 3500 tons per day.

The pressure applied to the pulverised coal is about 20,000 lb. per square inch, and no binding material is used in the course of the manufacture. The output of the factory with five machines working twenty-four-hour per day is about 750,000 briquettes, equivalent to 80 to 90 tons per machine. A research laboratory is attached to the plant.

Australian Mining Developments

The minerals produced to the end of 1935, which had values (in millions sterling) of considerable total, were: (1) gold 662, (2) coal 262, (3) silver-lead 150, (4) copper 100. Iron gave a figure of 23, tin 49, zinc 26. But in recent years (1915 onwards) the annual value of coal produced has often exceeded the value of gold won each year.

Although a surveyor named McBrien mentioned gold near Bathurst in 1823, it was not until 1851 that the gold rush began. In that year gold worth £1 million was won in Victoria; in 1852 seven times as many immigrants arrived in Melbourne as in the previous year, and in that year no less than £16 million worth of the metal was won. By 1861 the days of individuals working soft alluvial deposits were over; the steam engine and the mining company were at work. But in 1857 some 20,000 Chinese were mining for gold in Victoria and soon about 13,000 were in New South Wales.

Mining came to the rescue of more than one state when it seemed to be stagnating. It happened in South Australia, Queensland, and Tasmania. The influx of miners brought money for the farmers and usually water supply. In the last-named state payable gold was found in 1883; other mines were discovered and in 1892 the richest field in Australia, Coolgardie, was rewarding two prospectors with 500 oz. of gold from an exposed reef in a few hours.

In addition to the extensive use of machinery in the mining industry, the treatment of ores, and the refining of such metals as lead, zinc, and copper, is an important Australian activity. Lead-zinc-silver ore is mined and concentrated at Broken Hill and taken by rail to the seaboard. Since 1892 lead has been smelted at Port Pirie, South

Australia, and to-day the plant there is the largest individual lead smelting and refining works in the world. Lead ore is also mined and smelted at Mount Isa, in Queensland.

Zinc concentrate from Broken Hill is treated for the extraction of zinc by an electrolytic process near Hobart, Tasmania. Zinc concentrate is also produced from mines in Tasmania. The residue remaining after electrolytic treatment contains lead and silver; it is sent on to the works at Port Pirie.

There are large deposits of comparatively low-grade copper ore in Tasmania, where it is readily accessible; it is treated electrolytically. In Queensland the ore is mined and smelted. At Port Kembla copper is also produced and refined by electrolysis. At this centre copper tubes, pipes, and wires are made and in Sydney copper sheets and sections are produced.

From the above outline of the mining industries in Australia it is obvious that they are a source of wealth to the Commonwealth. Coal and iron are the two chief products needed for building up the heavy industries. There is plenty of coal, but no large supply of iron. In millions of tons the recent estimates of iron ore resources are :—(1) U.S.A. 10,450, (2) U.S.S.R. 10,300, (3) Britain 6000, (4) India 3326, and (5) Australia varying from 200 to 900. Under pre-war conditions the U.S.A. used about 70 million tons of iron ore a year.

A large number of other minerals, not mentioned above, such as antimony, arsenic, chrome, diamonds, salt, &c., are also produced.

The Iron and Steel Industries

The first trace of an ironfoundry is recorded for 1833 and afterwards a number of small blast-furnaces, foundries, and mills for rolling iron bars, tyres, and rails came into being. The output of these was insignificant when compared with the imports of iron and steel. It may be said that these industries scarcely existed in Australia before about 1915.

The Broken Hill Proprietary Company, Ltd. (B.H.P.), acquired control of the works of Australian Iron and Steel, Ltd., in 1935. In 1900 the company had been granted leases over a large area of rich iron ore deposits in South Australia. The ore was proved to contain almost 60 per cent. pure iron. Because of the extensive coking coal deposits in the neighbourhood, and the water and harbour facilities, it was decided to erect the steel works at Newcastle, which is 104 miles by rail north of Sydney and some 1200 miles away from the iron ore deposits. The firm had been at work in mining and metallurgical operations for some time, but in 1915 it began to manufacture pig iron and steel, billets, rails, and small quantities of steel for munitions. At the beginning the plant consisted of three open-hearth furnaces, a mill, and another one for blooming. During the war (1917) four additional open-hearth furnaces were built and three new mills installed. There were other extensions, so that the output rose from 86,400 tons in 1915–16 to 219,700 in 1921–22. In 1940 the annual output was in excess of a million tons.

The capacity of the blast-furnaces at Newcastle aggregated (1940) some 14,500 tons of basic iron a week. The steel furnaces have a combined capacity of 72,000 tons of ingots a month. Rails, structural steel, plates, angles, bars, and rods are produced. It is claimed that the range of products manufactured is more comprehensive than that turned out by any other steel works in the world. The combined production of the works at Newcastle and Port Kembla is more than a million and a half tons of iron and steel per annum.

In 1938 the company decided to install a blast-furnace at Whyalla, in order to smelt some of the ore mined locally. This new plant is now at work. For the purpose of supplying water for the plant and for other supplies needed in South Australia, a pipe line, 240 miles long, crosses the state, carrying water from the Murray River.

It was not long before works designed to manufacture iron and steel products were erected near to the steel works. Lysaght's mills at Newcastle and Port Kembla produce galvanised and black steel sheet. Rylands Brothers make wire and wire products. The British firm, Stewarts and Lloyds, manufacture iron and steel pipes and tubes. The Commonwealth Steel Company makes castings, forgings, and alloy steels. The Australian Wire Rope Company makes wire ropes. The Australian Iron and Steel Company at Port Kembla turns out centrifugally spun cast iron pipes.

In 1928 the British firm of Dorman, Long and Co., Ltd., and Baldwins, Ltd., in association with a local company, formed the Australian Iron and Steel Company, Ltd., with a capacity of about 175,000 tons of pig iron and 150,000 tons of steel ingot and castings per annum.

The whole problem of industry in the Commonwealth is greatly complicated by political considerations, such as tariffs and wages. There is also the policy of the Government (which owns the railways); it specifies the purchase of local manufactures, where possible.

The four main classes of purchasers of steel goods are public authorities, farmers, the building trades, and the metal manufacturing concerns. It is notable that the Commonwealth and State Governments, and the large municipalities, operate services, such as electricity supply, railways, &c., which are often in the hands of private enterprise in many other countries. At times these public authorities have borrowed large sums of money in order to carry out development schemes for irrigation, electrification of railways, bridge building, the improvement of harbours and docks, and other works demanding considerable quantities of steel. As the major part of the total steel used is purchased by these authorities, it is obvious that the progress of the industry depends very much on the amount of money spent on these public works.

The Romance of the Mount Isa Mines

It has been said that, of the numerous mineral fields that have been opened up throughout the world, in recent years, the most startling and in many respects the most spectacular have been the Mount Isa silver-lead field in the wilds of North-Western Queensland. This is regarded as the largest and the richest mineral deposit of silver and lead that has ever been discovered in the world. It is a vast treasure-house of great value, especially at the present time, to Australia and the Empire.

The story of Mount Isa is one of great romance, for it tells of civilisation conquering a wilderness. In the middle of a desert waste, a barren and inhospitable country, always regarded as "No Man's Land," there has been developed a thriving industry. Less than twenty years ago Mount Isa was unknown and unnamed. It is 600 miles from the coast, in a waterless and uninhabited district, where many a traveller had perished from thirst.

For nearly half a century numbers of hardy prospectors had been searching for gold in this area, but had found no trace of any mineral. Then a lucky, but penniless, prospector, named Miles, and a companion were in the region; one night Miles' horse strayed and, when searching for the animal, a piece of red-stained earth was accidentally noticed. It revealed a lump of rock, the weight of which made Miles pause. He took the lump away and a month later handed it to an assayer, who advised him to obtain more specimens. Miles did so, sent them some distance away to a smelter, and then looked for, and finally obtained, work on a cattle station. A year later, by chance, the restless Miles tried to obtain work in the district near to the smelter. He was then told that a letter at the Post Office addressed to him had been lying there for nine months. The contents amazed him, for they revealed that the stones he had so casually gathered were full of lead and silver. He immediately pegged a lease on the hill, which he named Mount Isa.

As soon as he had registered his lease the news spread and a great rush began. Men set out in thousands, some on camels, pack horses, mules, motor-cars, and others on foot. All along the wayside broken-down vehicles, abandoned in the rush, were to be seen. Very soon five hundred leases had been pegged out, covering an area of 24 square miles. There were all sorts of fortunes won and lost. It is said that one miner gave away a £40,000 lease for a cowhide, and later the original owner of the cowhide sold the lease to the developing company that took over the entire field for a sum of £40,000. However, Miles, the purchaser of the cowhide, took up another lease, sold it for a higher figure than the one given away, and was shortly afterwards killed in a motor-car accident!

Ultimately the developing company took over the entire field, and in ten years spent £4,000,000; in 1931 the production of lead and silver began. Thousands of tons of these valuable minerals have since been exported annually. In recent years the value of production has averaged nearly £1,000,000 per annum, and it is said that there is still more than 10,000,000 tons of ore in sight.

There is now a population of about 5000 white men at Mount Isa. The mines are equipped with up-to-date mining machinery, electric underground railways, and for that type of work the best mill and smelter of any known in the world.

A difficult problem was the supply of water. Millions of gallons were needed for mining operations. In a creek 20 miles away a large dam was built, with a capacity of 1400 million gallons. It cost more than £130,000 and water is conveyed from the reservoir to the mines in 12in. pipes.

It had been supposed that white people could not live long at Mount Isa because of the heat and the insects. Modern engineering equipment, such as electricity and refrigeration, made the region habitable. It is between 1200ft. and 1500ft. above sea level, and although the summer temperature by day is often as high as 120 deg., the nights usually are cool. Great praise is due to the developing company, which has built comfortable homes at reasonable rents. There is a railway that connects Mount Isa with Townsville, on the coast, nearly 600 miles away. It is a remarkable story and makes one wonder what other treasures may be found in the arid districts of Australia.

(To be continued)

L.M.S. Workshop Salvage.—Since 1940 no less than 669,962 used chair screws recovered from the track have been used by the L.M.S. Railway in lieu of new screws on new and reclaimed sleepers.

Modern Railway Signalling Practice in America

By O. S. NOCK, A.C.G.I., B.Sc., A.M.I. Mech. E.

No. V—*(Continued from page 231, September 17th)*

Coded Track Circuits

ONE of the most striking features of recent American signalling practice is the development of coded track circuits. It was in connection with the control of continuous cab signals on the Pennsylvania Railroad that coded currents were first used in the track rails, though in the first installations these coded currents were superimposed upon the continuous-flowing track circuit currents used for the control of the wayside signals. American signal engineers were, however, not long in realising that in coded track circuits there lay great potentialities, not merely for cab signalling and automatic train control, but for ordinary signalling—from a variety of aspects, too. The principles involved may be described first with particular reference to a section, 109 miles long, of the New York to Washington main line of the Pennsylvania. Electric traction is employed throughout and the signalling is arranged to suit maximum train speeds of 90 m.p.h. In this 109-mile section there are twenty-seven interlockings, and between these automatic blocks about 8000ft. long are installed. Alternating current at a frequency of 100 cycles per second is used for the track circuits.

Current is fed to each track circuit through an instrument called a code transmitter. This includes a continuously running induction motor, which, through a train of gears, revolves a camshaft at 15 r.p.m. The cams carried on this shaft each have a different number of equally spaced depressions on the periphery, and associated with each cam there is a contact operating arm. Thus, in the case of a cam having five depressions, the corresponding contact is broken seventy-five times per minute. Fig. 37 shows in diagrammatic form a stretch of line equipped with coded track circuits; current is fed in at the leaving end, and the frequency of interruption is determined by the condition of the track circuit immediately ahead. The track circuit at the right-hand end of the diagram is occupied, and its track relay shunted; in these conditions coded current at seventy-five interruptions per minute is fed into the track circuit next to the left. When coded current is flowing in a track circuit, as in all those shown in the diagram, except that in the extreme right, the track relay, situated at the entering end, follows the code—that is, it is de-energised 75 or 180 times per minute according to the conditions.

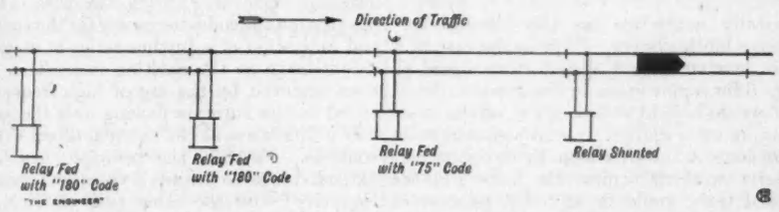


FIG. 37—LINE EQUIPPED WITH CODED TRACK CIRCUITS

The pulsations of the code, as registered by the operation of the track relay, are passed on to a decoding unit, consisting of a resonant transformer unit and a rectifier; this decoding unit controls a selective relay, which is energised by the 180 cycles per minute code, but not by the 75 code. The principle of three-aspect signalling control is thus established; if the track relay is de-energised the signal giving entrance to the track circuit displays "Stop"; if the track relay is energised and the selective relay is de-energised (75 code) the signal displays "Approach"; and if the track relay is energised and the selective relay is also energised (180 code) the signal displays "Clear." The control of each signal, depending upon the aspects displayed by those ahead and also upon the occupancy of the track circuits, is thus effected entirely through currents flowing in the track rails. No line wires at all are required. Furthermore, since current is fed in at the leaving end of the track circuit, this same coded current can be utilised for continuously controlled cab signals, through an inductive pick-up at the front end of a locomotive. This use of coded track circuits for both wayside and cab signalling has now been standardised on the Pennsylvania.

Increased Safety

Quite apart from the two very important uses just mentioned, namely, elimination of line wires in automatic territory and control of cab signal indications, coded track circuits include one feature that definitely increases the general safety of the signalling system. It was previously explained that the track relay is included in the control for both "Approach" and "Clear" indications; but since the current flowing in the track rails is alternately on and off (if the track circuit is unoccupied), it is clear that the track relay contacts cannot be directly included in the signal control circuits. The operation of the track relay is decoded by the circuit shown in Fig. 38, for the purpose of signal controls. The alternate picking up and dropping away of the relay armature causes current to flow first in the upper and then in the lower half of the transformer primary winding; the changes in flux caused by the reversal of current direction induce voltage first in the lower and then in the upper half of the secondary winding. The connections from the transformer secondary through the track relay contacts are such that the low-frequency A.C. induced is rectified and fed as continuous D.C. to the track circuit detector relay. If, for any reason, coding should cease, leaving the track relay either energised or de-energised continuously, the detector relay would be de-energised, since the changing of flux in the decoding transformer would cease under these steady conditions. Thus the arrangement shown in Fig. 38 not only decodes the track relay operation and changes it to a form suitable for direct signal control, but it also affords a continuous proof that the track relay is functioning properly, and on this account enhances the safety of the signalling system as a whole.

The use of A.C. track circuits on the Pennsylvania electrified lines is necessary on account of the traction return current being conveyed through the rails. In steam or oil engine operated territory D.C. track circuits are used, and the Pennsylvania has recently completed one remarkable installation on the main line between Pittsburgh and St. Louis, including track circuits up to 11,000ft. in length. The particular section is 110 miles long, double-tracked throughout, and contains interlockings at only six intermediate points; the intervening distances between the interlockings are automatically signalled in block sections ranging from about 3 to 4 miles in length. The longest sections thus consist of two track circuits, each of about 11,000ft., and the code flowing in the rails is relayed from one track circuit to the next, so maintaining the same code throughout the block section, though still with no line wires. Compared with track circuits using non-coded current, the length of 11,000ft. is altogether exceptional; in this country it has been found generally that 3000ft. to 3500ft. is about the maximum length for D.C. track circuits, and the great increase possible with coded currents is a measure of the increased train shunting sensitivity of coded track circuits.

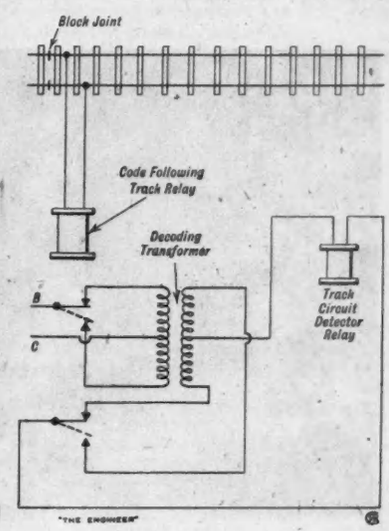


FIG. 38—DECODING CIRCUIT

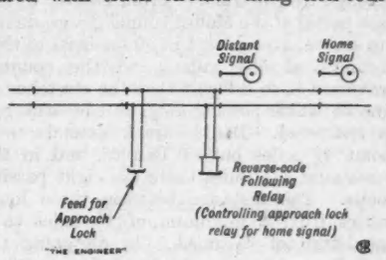


FIG. 39

This Pennsylvania installation includes a further interesting feature made possible by coded track circuits. At the interlockings approach locking control is applied to the signals operated from the cabin, in accordance with the usual practice. In the ordinary way this would need line wires from the relays associated with the track circuits on

the approach side of these signals. In this installation, however, the principle of coded current was extended to provide approach locking control, without any line wires. For the ordinary coded track circuit control the current, whether interrupted 75 times per minute, 180 times, or at any other frequency, is on and off for equal periods. The "off" period of the code has here been utilised for sending a code in the reverse direction through the track circuit; that is, fed in at the entering end. Fig. 39 illustrates the application of this principle to the approach locking control on the home signal at an interlocking; that signal becomes approach locked when a train enters upon the last track circuit before the distant signal.

FIG. 40—WESTBOUND TRAIN APPROACHING MOFFAT TUNNEL

MOFFAT TUNNEL ROUTE SIGNALS

A most interesting example of modern signalling, including coded track circuits, is to be seen on the Moffat tunnel route of the Denver and Salt Lake Railroad. Since its completion recently this route, providing a short cut from Denver to the West, through the Colorado Rockies, has assumed major importance; it is used by certain transcontinental passenger services operated by the Denver and Rio Grande Western Railroad, and heavy through freight trains. From Denver to the east portal of the Moffat tunnel the gradients are severe, averaging 1 in 50 for most of this distance of 52½ miles, and the country traversed is so difficult that the stretches of line on which passing loops can be arranged is restricted. Double track extends to a point 4¾ miles out of Denver, and in the remaining 47¾ miles there are eight passing loops. The distance between these loops varies from a minimum of 1½ miles to a maximum of 6½ miles. In designing the signalling system a variety of circumstances had to be considered. First of all, there was the prime necessity of keeping ascending trains on the move as much as possible; secondly, although present traffic was not unduly heavy, it was unevenly spread through the day, and peak periods occurred, particularly in the morning; and thirdly, although traffic movements are at present directed by train orders a change over to C.T.C. was envisaged in the near future, if traffic over this new route developed to the extent anticipated.

The varying distances between passing loops made it difficult to space the signals scientifically to suit the speeds of ascending trains, and the extremely rocky nature of the country—almost continuous curvature, numerous short tunnels, out-jutting cliffs, and other obstructions to sighting—often prevented the location of the intermediate signals in the most ideal position. The photograph reproduced in Fig. 40 showing a westbound passenger train ascending the gradient gives a very good idea of the local conditions the signal engineers had to face. Between loops a signal spacing of about 2 miles was aimed at, and by the use of coded track circuits this distance was covered without any need for cut sections; actually the longest track circuit installed was 11,190ft. Fig. 41 shows a typical arrangement of signals between two passing loops; they are automatically controlled on the absolute-permissive block system. Thus in the case of a train leaving loop A the starting signal at loop B for a movement in the opposite direction would be held at danger; if, on the other hand, it was required to send a second train from loop A towards loop B, ordinary permissive working comes into force and the second train would be signalled to leave as soon as the first train had passed signal C.

Although coded track circuits are used, the control of these automatic signals is carried out over three line wires, lines that will eventually be used for a three-wire C.T.C. system. The whole section of 128¼ miles from Denver to Orestod, including the 52½ miles of ascent to the tunnel under the Continental Divide, and the further 76 miles of descent beyond, is ideally suited to C.T.C. control. The tunnel itself is 6¼ miles long, but is operated as a single block section; owing to the damp inside the smoke from one train is such that it would be quite impracticable for a second train to follow a few minutes later in the same direction. Even if the locomotive crew were not asphyxiated by the fumes, it would be quite impossible for them to see any intermediate light signals. The track circuiting conditions are very bad owing to this same dampness and to the amount of cinder thrown from the locomotives. The tunnel block section had for this reason to be cut into ten sections, with a maximum length of 4600ft., even though coded track circuits were used.

In considering a lay-out of this kind in relation to the signalling equipment provided the use of train orders must be borne in mind. The signalling acts as a safeguard against two trains entering a block in opposite directions, but at the same time providing for close following moves. The train dispatcher and for that matter the operators at intermediate loops do not require to know the exact position of each train; the train orders are prepared some time previously. On this account no track circuit indications are provided, and, of course, the signalling scheme is greatly simplified thereby. Unless the line in question is C.T.C. controlled it is not the practice in the U.S.A. to provide track circuit indications in automatically signalled territory.

FIG. 41

CODED CARRIER CONTROL

In the fourth article of this series mention was made of the limitations in size of lay-out with the two-wire and three-wire C.T.C. systems. In seeking to overcome these limitations the Union Switch and Signal Company has developed a means of superimposing upon an existing two-wire C.T.C. installation the codes necessary for the control and indication of a further series of stations as extensive as the existing one. This has been achieved by the use of high-frequency coded carrier currents flowing over the same pair of line wires as the existing direct C.T.C. controls. Further, the principle has been extended so as to include a voice communication circuit on the same pair of wires, to permit of which the line circuit must necessarily be equipped with suitable filters so as to prevent the ordinary C.T.C. impulses on the line from interfering with speech. The coded carrier currents used for control of the signalling on the second section of line have a frequency a little above that of the voice range. Even though this principle is comparatively new, a further striking development has taken place: with the possibility of adding a telephone circuit to the ordinary two-wire C.T.C. line already demonstrated it has been a comparatively simple matter to reverse the process and superimpose ordinary C.T.C. controls upon existing telephone lines. Thus the position has been reached that where telephone lines already exist a C.T.C. installation can be built that requires no additional line wires and, moreover, if coded carrier control is used,

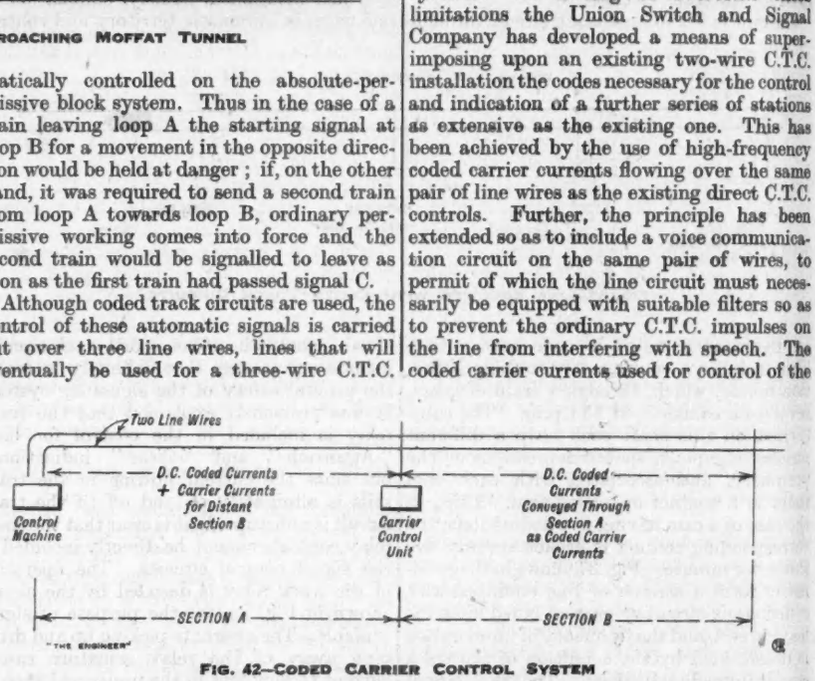

Two Line Wires
D.C. Coded Currents + Carrier Currents for Distant Section B
D.C. Coded Currents Conveyed Through Section A as Coded Carrier Currents
Control Machine
Carrier Control Unit
SECTION A
SECTION B
"THE ENGINEER"

FIG. 42—CODED CARRIER CONTROL SYSTEM

an installation of almost unlimited size.

Fig. 42 illustrates diagrammatically the scheme of working of such an installation. In this particular example the control machine is shown located at one end of the section. Ordinary D.C. coded control is applied to the first section, this representing about thirty-five stations. On the two line wires throughout this first section coded carrier currents are superimposed for the control of signalling apparatus on the second section. At the end of the first section a coded carrier control unit receives the high-frequency currents sent out from the control machine, and delivers them to the second section of line as ordinary D.C. codes. Conversely, this same unit receives the incoming D.C. indication codes from various stations on the second section of line and passes them back to the control machine as carrier indication codes. The principle is capable of further extension, for by the use of different frequencies more than one series of carrier coded controls may be superimposed upon the one pair of line wires.

The enormous increases in traffic on single-track main lines in the Middle West and Western States, due to war conditions, have made C.T.C. a vital necessity, since materials were not available for providing additional tracks. Several installations that were in hand at the time of the Japanese attack on Pearl Harbour have been rushed through to completion and others specially authorised for dealing with wartime traffic. In several of these the use of coded carrier control has, by the elimination of new line wires, enabled a valuable saving in copper to be made. During the year 1942 no less than 807 track miles in America were equipped with C.T.C., these including the control by coded currents of 1294 pairs of points. It is anticipated that the present year will show a substantial increase over these figures.

Conclusion

While describing some of the latest trends in American railway signalling, it has been the author's intention to present the subject in a way that may suggest some possible applications of the principles concerned on British, Dominion, and Colonial railways. As was stressed in the preamble, railway operating conditions in America are particularly favourable for the development of bold signalling projects, and the results of such enterprise are worthy of careful study. The whole field of C.T.C. is a particular case in point. Owing to the density of traffic and the completeness of interlocking arrangements, there would not appear to be a very wide field for C.T.C. in Great Britain, but the case is very different overseas. Some of the Dominions and Crown Colonies include long sections of line over which traffic operating conditions are very similar to those in the Middle West States of America. The problem of line capacity has, in more than one case, become acute, though so far the situation has been met by increasing train loads and the use of locomotives of the Beyer-Garratt articulated type, which, having due regard to the gauge and nature of the permanent way, are of altogether exceptional tractive power.

But on any railway there is a physical limit to locomotive capacity, and if business continues to increase, as one is optimistic enough to expect in the period of post-war reconstruction, there will inevitably come a time when line capacity must be increased still further. All the same, while C.T.C. is an extremely attractive proposition, its introduction in what might be termed virgin signalling country is not a matter to be considered solely from the traffic operating point of view. The lines equipped must be continuously track circuited; a staff competent to maintain the apparatus must be recruited and trained, and this latter may well prove a serious stumbling block in certain tropical units of the British Empire. At home all lengthy sections of single-line railway are, of course, fully signalled and worked on the electric staff or tablet system. But while a high degree of safety is thereby provided, the regulation of traffic is at times apt to be cumbersome, and once delays have begun to mount up it is not easy to make a recovery. Though not reaching the proportions experienced on American railways worked under the train order system, such delays represent a dead loss, quite apart from the loss of prestige due to the late running of important and widely publicised passenger trains. The time may well be approaching when it will be found expedient to replace the comprehensive mechanical signalling arrangements on some such lines by C.T.C., not primarily to effect any reduction in signal operating and maintenance charges, but mainly to secure a more efficient use of the line.

Letters to the Editor

(We do not hold ourselves responsible for the opinions of our correspondents)

"THIS FREEDOM"

SIR,—Permit me to say that your admirable leading article of September 10th and its appreciation from the pen of Mr. W. J. Chambers, in your to-day's issue, constitute most fascinating reading, but they also offer very perplexing food for thought.

Is not individualism bound to fail in face of collectivism until such time as we, all of us, are really capable of thinking and acting collectively, *i.e.*, until we merit to enjoy "this Freedom"?

Marshal Stalin in Moscow, some years ago, when asked by Monsieur Boncourt, the French statesman and representative of one of the most logical nations, as to whether he had succeeded in his endeavour to improve the mentality and moral outlook of his co-nationals, is stated to have replied rather cynically, perhaps a little despairingly: "We have tried hard, but we soon came to the conclusion that we were confronted by a rather hopeless task; all we can do is this: we can force people to behave as if they were good and true!"

Whether this story is mere gossip, whether it is true or not true, it must be obvious to all that the Russians could not have fought so persistently and on the whole so successfully if they had not willed collectively to free their own homeland from the enemy, a homeland owned by them collectively and not by a few individually; certainly the individualistic leadership of Marshal Stalin appears to have been of immense, of paramount importance, but this would have been of no avail if he had not been able to think collectively with the great mass of his soldier nation, if the affinity between him and it had not been a real live thing.

Confucius, the Chinese philosopher, when he made the word "Jên" the pivot of his Confucian thoughts, and aimed at making men "manly," capable of sacrificing their lives for a just cause—later, early Christians expounded the words "charity," "love," "benevolence," and our first leaders of the Church, Popes and Bishops strutted about the world, armed to the teeth, presumably to force things, in anticipation of the doctrine ascribed to Stalin—did perhaps not realise fully—or did he?—that man is a poltroon at heart and becomes an animal in fact, as soon as he apprehends that the bread-basket may be hung too high and hunger looms ahead, a deplorable achievement after 2000 to 3000 years of consistent education in, and assimilation of, profoundly ethical values!

Do we really merit enjoying "this Freedom" before we demonstrate our willingness and ability to lower the bread-basket to within the reach of all, before we can say: want of work, also shirking of work, apprehension of a needy future and untended sickness are things of the past?

All above may appear strange from a Swiss Republican by birth and conviction. When political maturation of nations is permitted to be a factor in the equation, my attitude may not, however, be so unreasonable.

G. WUTHRICH.

London, September 17th.

Sixty Years Ago

An Aerial Bombardment of Woolwich

WOOLWICH ARSENAL and the surrounding district suffered their first aerial bombardment on September 24th, 1883. The casualties amounted to two killed, although others escaped death or injury by a narrow margin. We were able to give a personal account of the incident, as a representative of this journal happened to be visiting the Arsenal at the time of its occurrence. . . . Sir William Congreve, in 1806, was the first to advocate the use of rockets as offensive weapons in warfare. The Congreve war rocket carried an explosive charge in its head and a stick screwed into its base kept it headfirst in flight. Improvements were introduced by Hale, the chief being the abolition of the stick. In the Hale rocket steadiness in flight was secured by imparting rotation to the missile, the gases emerging from its base being for that purpose caused to impinge against curved blades or vanes partially surrounding the exit holes. The Hale rocket was made in various sizes up to about 2ft. in length and weighing 24 lb. The body consisted of a mild steel tube fitted with a cast iron head and base. The tube was filled under pressure with a mixture similar in composition to gunpowder. On the date we have mentioned some mishap occurred in an isolated shed in Woolwich Arsenal, in which a man and a boy were painting the casings of charged rockets. Fire broke out within the shed and for over an hour rocket after rocket flew upwards from it in all directions. Altogether about 500 of them were believed to have gone off. Sailing skywards, they descended over a wide area, some coming to earth as far away as Shooter's Hill and Plumstead Marshes, some two miles or so from the shed. The man and boy lost their lives. That no further casualties occurred was explained by the fact that the rockets for some reason which we failed to gather were fitted with heads containing a block of oak instead of an explosive charge.

INWOOD'S TABLES.—Sir Frank Gill has written a Foreword for a special edition of Inwood's Tables of Interest, abridged for engineers. He writes:—"It is all to the good that the publishers should decide to issue a selection of these tables in anticipation of a demand which they expect will arise from a new type of user of these kinds of tables, viz., engineers. For the trend seems irresistible. Young engineers must be trained that engineering does not merely consist in the ability to apply technical knowledge to works, but that they must with equal competence give economic consideration to their problems. While it is obvious that a technical solution cannot be put into practice if it is too expensive, it is not always realised that engineers must make alternative plans for filling the requirements of any project and use economic analyses to help in deciding which of the alternative plans to select. There is also much misunderstanding as to how the economic analyses should be made. For this work interest tables are essential. It would be a monstrous waste of time for any engineer to calculate the figures for himself."

The Engineer

SEPTEMBER 24, 1943

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FUEL ECONOMY

THERE are many cases of managements being taught their own business by outsiders. An investigator comes in to a works from the outside and for a fee, generally substantial, tells the owners what they ought quite well to have known. The readiness with which they accept the recommendation of the investigator is, in fact, sufficient evidence that they did know all the time, but for some reason had overlooked or neglected the obvious. It would seem that managers often have blind spots. Custom or habit, or maybe mere mental inertia, prevents them from seeing certain things which are visible at once to the onlooker. That is one very good reason why the entrance of new and young blood into factories should be encouraged. They will see things to which habit has made the old stagers blind.

Several excellent examples of this blindness are given in "A Review of the Work of the Fuel Efficiency Committee," which is printed as revised to date on other pages of this issue. The Fuel Efficiency Committee was set up in 1941, when it had become apparent that there would be a shortage of coal and oil. In its equipment is included a "Direct Combustion Engineering Advice Service" operated by a staff of forty-five "combustion engineers," supported by the part-time voluntary assistance of many experts engaged in industry, of whom some six hundred and sixty are now supplementing the work of the Ministry's own engineers. This little army of investigators has visited nearly ten thousand factories, and it is not surprising that many cases of inefficiency have been discovered. At the same time, the Committee's estimate that saving amounting to 10 per cent. of the annual consumption is attainable may cause some surprise. Nearly half of all the coal raised in this country is consumed by big users like electrical power-houses, gasworks, steel works, and so on, which have paid great attention to fuel economy and are not likely to have overlooked obvious and easily removable causes of inefficiency. It is in a high degree improbable that anything approaching 10 per cent. of saving is immediately possible in concerns of this standing. But obviously if a saving of 10 per cent. of coal has to be effected by half the total number of consumers they would have to reduce their consumption by 20 per cent. That is a big order, but we shall not say that it is impossible. There has always been a great deal of waste of fuel in the smaller concerns, particularly those in which fuel represents only a small fraction of the cost of operation. The Review gives a number of examples of waste. An engineering company was using two boilers where one would have taken the load simply because the "fireman thought it was easier to work"; a laundry had neglected its boiler setting and brickwork and other small avenues for waste; a textile mill had allowed dampers to get out of order, so that its economisers were working inefficiently; a glass manufacturer made such changes in burners and other details that the consumption of gas was reduced by about two-thirds; in the hosiery industry a saving of 30 per cent. of fuel was effected by more intelligent firing and attention to a manually controlled heating system. These are cases of waste through negligence. On the other side, the Committee gives examples of the saving of fuel by using neglected materials. The railways have devised a furnace—described on another page—for burning smoke-box char and a Welsh colliery is burning slurry, whilst some of the big electricity supply corporations have by propaganda succeeded in getting the peak load lowered. These cases, taken in the lump, show the kind of work that the Committee is doing and indicate the success it is achieving.

It has been frequently pointed out that efficiency and economy are not necessarily one and the same thing; the cost of efficiency in money and time may sometimes outweigh the saving effected by it. The Fuel Efficiency Committee is not called upon to bother its head about that. Its business is to bring about a reduction in the consumption of fuel—particularly coal—and whether the saving is worth while or not from a strictly economical standpoint does not enter into the matter. However small may be the relation between the cost of fuel and other expenses, there exists at the time being a stern necessity to economise even though the economy be dearly bought. Fuel is more important than pounds sterling. It appears to be evident from the Review that quite a considerable amount of coal and oil is in fact being saved partly by the prevention of sheer waste, owing to indifference and negligence and partly by reorganisation and to a less extent by the utilisation of fuels, like slurry, that are normally regarded as worthless.

What is "Work"

A CORRESPONDENT asks us to discuss the thesis that "It's impossible for work to be a pleasure. When a thing is a pleasure it ceases to be work." For ourselves we hold that thesis to be quite untenable, but as it is often advanced, and as it has certain psychological implications—a fashionable source of conversation these days—it may be worth considering it for a few moments.

For convenience we may divide work into two main classes—mental work and physical work. Physical work is work in which the principal element is the use of the muscles; mental work is that in which the brain plays the principal *rôle*. That there is overlapping is obvious. The workman operating a machine must, in most cases, concentrate his attention—brain work—on what he is doing; the designer in the drawing-office must use his hands as skilfully as his head. We may neglect these threshold cases and consider only those that are clear cut. There is a well-known story of a mechanic who was so persistent in the opinion that brain work was not work at all, that his employer took him from the bench and gave him an office job. In a fortnight he asked to be returned to the shops, and never again spoke slightingly of brain work. There is some point in this story, for many a workman underrates the work of the management; to him work means physical work and any other kind is no more than a pleasant and profitable way of passing the time. We come, then, in the first place to the question: Does a workman, a mechanic, for example, regard his work as something unpleasant and distasteful? As far as genuine craftsmen are concerned, we have no doubt that the answer is in the negative. Their work is undoubtedly creative, and it is common knowledge that such work, well done, gives a feeling of satisfaction. To see something growing into being under our hands fills us with pleasure. Whether it be done for a weekly wage—and is therefore part of our work—or is done in our own homes for the love of doing, does not alter that fact. The joy of creation still remains. It is doubtful if the best work is ever executed unless that feeling of satisfaction in achievement is present. The workman who does not take a pride in his work will almost certainly skimp it. But, it may justly be said, not all workmen have to exercise true craft. Many have to operate machines that are set for them and over which they have little control. Others are engaged on repetitive operations that have become automatic. Even then the pleasure is not invariably lost. Apart from

the fact that the achievement of a certain quantity in a certain time gives its own feeling of satisfaction, there is a quite undefinable pleasure in doing the same thing over and over again, particularly if the end to which it is moving can be seen. It has been found by confirmed experience that if the object of repetitive work be explained to workpeople, if they are shown how their little contribution fits into a general scheme, the sense of monotony is removed, and they do with some pleasure what before had been unadulterated drudgery. Are we to say with our correspondent that as soon as that happens their occupation ceases to be work? We think not. and when we turn from physical to mental work, his thesis is equally untenable. The man who takes most interest in his work is the man who will do it best, and interest is only a particular form of pleasure. Again, there is the satisfaction of achievement of the task itself or because it brings one nearer to some desired object. Those unfortunates who have got into a wrong groove and can neither like their work for its own sake nor for what it may lead to are to be deeply pitied, but is it just to the others to say that these unhappy ones are the only workers?

Our conclusion of the whole matter is that, though work may be unpleasant, it does not cease to be work if it happens to be pleasant, and with our hands on our hearts and our heads in the nursery we say with Dr. Watts:

> "But thanks to my friends for their care in my breeding,
> Who taught me betimes to love working and reading."

The pH Value of Boiler Feed Water

By R. LL. REES, M.A., F.I.C.,* and J. JACKSON, Ph.D., B.Sc., A.I.C.†

THE quality of feed water for high-pressure boilers may be defined with sufficient exactness from a knowledge of four quantities: the electrical conductivity, the concentration of dissolved oxygen, the pH value, and the concentration of ammonia.

Electrical conductivity serves as a measure of the concentration of dissolved ionic impurities. These may be introduced into the feed water by condenser leakage, by carry-over from the boilers or evaporators, or by ammonia which is released in the evaporators and boilers and redissolved in the condensate.

When the pH value of condensing water does not differ greatly from that of normal condensate—and such a difference is rare—condenser leakage has little or no effect upon the pH value of the feed water, although its electrical conductivity is increased. The carrying-over of highly alkaline water from boilers or evaporators, on the other hand, increases the pH value of the feed water as well as its electrical conductivity. Thus, in the absence of complications, the pH value shows whether contamination which affects the electrical conductivity is due to condenser leakage or not. This is especially valuable, as condenser leakage is very harmful and must be rectified promptly or its more injurious effects counteracted meanwhile by suitable water treatment. Carry-over from boilers or evaporators is, of course, undesirable, but not as serious as condenser leakage. Observation of the pH value of feed water therefore gives a prompt and valuable clue to the course of action required when the electrical conductivity is seen to rise.

The corrosive properties of fairly pure condensate appear to be governed mainly by its dissolved oxygen content and the pH value, and to a smaller degree by the electrical conductivity. There is good reason to believe that the concentration of oxygen dissolved in these pure waters is the major factor in controlling the extent of pitting, which is the most serious form of corrosion owing to the speed at which the dissolution of a given amount of metal causes perforation of the structure.

Experience over many years has shown that only negligible pitting of steel occurs in a pure condensate, if the concentration of dissolved oxygen does not exceed 0·01 ml. O_2 per litre, the pH being about 7·3, which is the natural value of the untreated condensate. There are theoretical and practical grounds for believing that larger concentrations of oxygen may be tolerated if the pH value is higher; but a pH-oxygen relationship for the practical control of pitting has never been worked out, and can only be explored properly by long-term experiments on the plant. The pH value of 9, which is often quoted as being desirable for the control of corrosion, appears to be derived from experiments made at room temperature, and a lower figure would probably be found satisfactory in many power plants.

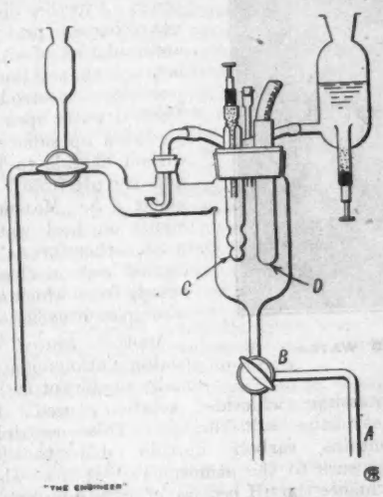


FIG. 1

The pH value of a pure deaerated condensate is close to 7. It may be raised deliberately by the addition of an alkali, such as caustic soda, or accidentally by carry-over from boilers or evaporators, or by the presence of ammonia in the system. Ammonia has found its way into the condensate at many power stations as a result of the heavy wartime chlorination of mains water, which inhibits the action of nitrifying bacteria, and so permits ammonia that would normally be oxidised before it reached the power station to enter the evaporators, whence it is distilled into the feed system. A concentration of ammonia equivalent to 0·1 p.p.m. NH_3, which is readily obtainable in this way, raises the pH value of the condensate to about 8·4 and the electrical conductivity by about 1 micro-mho per centimetre cube in the absence of carbon dioxide.

Measurement of pH Value.—The measurement of the pH value of boiler feed water is thus seen to be desirable, first, in order to decide whether the water should be dosed with alkali; secondly, to control the addition of alkali if it is found to be necessary; and thirdly, as a means of diagnosis, indicating whether an unexpected rise in the electrical conductivity of the water is due to condenser leakage or carry-over.

In view of the importance of this measurement, it is unfortunate that on account of the great purity of the water it has constituted, until recently, one of the most difficult tasks with which the power station chemist may be confronted. The slightest exposure of a very pure water to the atmosphere during sampling or measurement permits the solution of enough carbon dioxide to lower the pH value considerably—a fact which has sometimes led to gross misinterpretation of the corrosive properties of the water, and to harmful overdosage with alkali. On the other hand, such a water may derive sufficient alkali from the glass of the vessel in which the sample is collected or stored to raise its pH value appreciably.

The familiar method of measuring pH value by means of indicators, which is useful and simple in most instances, is not accurate when very pure water is the subject of the test, because the acidic or basic nature of the indicator renders it liable to change the pH of the water under examination. The so-called isohydric method, which is designed to avoid this possibility, has many inconveniences when the atmosphere must be rigorously excluded from the apparatus.

These difficulties occur to a serious extent only when the water is very pure. An early instrument for use with boiler feed water employed the indicator method.‡ Samples were withdrawn intermittently by an automatic device and dosed with indicator solution. The coloured liquid was then examined by an operator or by a photo-electric cell.

Electrochemical Methods Using a Potentiometer

The most accurate determination of pH is carried out by measuring the potential of a suitable electrode introduced into the solution. A hydrogen electrode, which is the standard type, consists of a small piece of platinum foil covered with a thin layer of finely divided platinum, over which pure hydrogen is bubbled. A second, reference, electrode is necessary, its potential with respect to the solution being, of course, independent as far as possible of all the concentration and composition variables. A calomel half-cell is usually used, connection to the solution being made through a salt bridge, *i.e.*, a tube containing concentrated potassium chloride solution.

The potential of the hydrogen electrode, and therefore the E.M.F. of the cell so constituted, depends on the pH. If the potentiometer used to measure it is compensated for temperature effects in the electrode system, it may be calibrated directly in pH units. An instrument of the self-balancing type may be made to operate a recorder, furnishing a permanent graph of pH against time.

As early as 1922 Arthur and Keeler§ described "A meter for recording the alka-

* The London Power Company, Ltd.
† Marconi Instruments, Ltd.

‡ British Patent 291,174 (1927).

§ R. C. Arthur and E. A. Keeler, *Power*, 1922, 55, 768–70.

linity of boiler feed water," which was at first based on the use of a hydrogen electrode. The water tested passed through a filter to a platinum gauze, over which hydrogen drawn from a gas cylinder was bubbled. The readings were occasionally erroneous—presumably indicating too low a pH—because of the presence of excessive concentrations of oxygen. The difficulty was overcome by converting the hydrogen electrode into an air electrode—that is to say, an oxygen electrode in which the gas is supplied by the atmosphere and at its atmospheric concentration. The sample bled off from the boiler feed system was thoroughly aerated with air purified from carbon dioxide and other acidic or basic components present, and then led past the electrode. This arrangement functioned satisfactorily.

It should be observed that whilst many workers‖ have arrived at the conclusion that the hydrogen electrode (and therefore presumably the oxygen electrode) is not very reliable if applied to extremely lightly buffered systems, such as a fairly pure condensate, certain sources of error are absent when the liquid is flowing. At the same time it is evident that the process of aeration, like the treatment with hydrogen gas, must affect the pH in the presence of volatile acids, such as carbon dioxide. Thus slight errors are possible from this source in the neutral and weakly acid ranges.

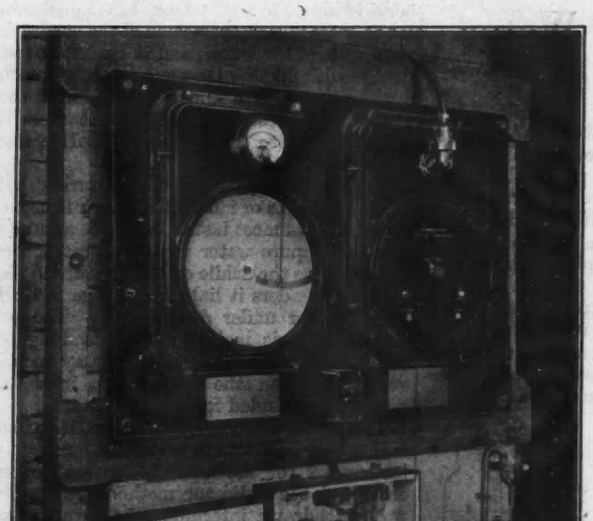


FIG. 2—PH RECORDER FOR BOILER FEED WATER

THE GLASS ELECTRODE

The emergence of the glass electrode as a means of precise pH measurement except under extremely acid and alkaline conditions has led to its application in boiler feed water examination. The glass electrode is simply a membrane of special glass separating the test liquid from one of known and constant pH. In its usual form it consists of a thin bulb blown on a stem of ordinary soda glass tubing and contains a buffer solution with some suitable electrode lead; for example, a silver/silver chloride or calomel electrode may be used when the buffer solution contains chloride. The special glass may be regarded as a membrane permeable only to hydrogen ions and the potential difference between the solutions on its two sides is governed by the ratio of their hydrogen ion concentrations. The glass electrode may therefore generally replace the hydrogen electrode, and when set up with a calomel half-cell or other reference electrode the E.M.F. of the cell becomes a measure of the pH solution in which the glass electrode is immersed.

The glass electrode differs from those previously described, in that it introduces a very high resistance into the circuit and is rather readily polarised. E.M.F.s must therefore be read with an electrometer which draws very little current from the cell.

The special glass used for electrodes loses alkali at a rate sufficiently high to affect the pH of very lightly buffered solutions. Used for boiler feed water, therefore, precautions against errors from this inevitable source of contamination are necessary. According to some authors, it is sufficient to take a measurement without undue delay; alternatively, agitation, *e.g.*, by inert gas, distributes the contaminating alkali throughout the bulk of the solution instead of leaving it to accumulate in the neighbourhood of the electrode, so minimising any error. A further obvious recourse to prevent accumulation of alkali is to flow the test liquid past the electrodes. Neutral water open to air takes up sufficient carbon dioxide to reduce the pH from 7 to about 5·5. Measurements on feed water must, therefore, be carried out in closed vessels from which air is completely excluded.

Another source of contamination not normally significant is the potassium chloride solution used to make the salt bridge. This certainly contains carbon dioxide due to its exposure to the atmosphere. It may also influence the pH because of other impurities, as well as indirectly by the relatively large increase in electrolyte concentration to which it can give rise. The salt bridge, therefore, should be so connected that passage of the contents of the salt solution to the glass electrode chamber by diffusion or convection is effectively obstructed.

Hanlon¶ has described an apparatus for carrying out measurements of pH of condensed boiler steam, which show how these precautions are effected. The sample is introduced into a Pyrex glass chamber in which the glass electrode is mounted under an atmosphere of nitrogen. The junction of the test liquid and the salt bridge solution is made in a vertical tube at the base of the chamber, the flowing liquids then passing to waste.

PH RECORDING UNIT EMPLOYING GLASS ELECTRODE

An apparatus utilising the glass electrode in which the electrodes are connected to a recording electrometer to provide a continuous and permanent record of the indicated pH value was installed early in 1942 at the Battersea power station. A diagram of the apparatus is shown in Fig. 1. From the main feed water flow line a slow stream is bled off through copper tubing and a stopcock into the electrode system. It traverses the inlet tube A and enters the glass electrode chamber through a three-way tap B. The glass electrode C is of simple construction. It will be observed that the lead to the internal solution of the electrode, a calomel half-cell, projects beyond the stopper supporting the electrode, so that its temperature is sensibly that of the atmosphere.

Suitably insulated leads are taken from the electrodes and the temperature compensator D to a self-balancing potentiometer and recorder. Long-term stability in the recording apparatus is achieved by simplicity of design and by a double stabilisation of the operating voltages and currents in the circuit so that these are quite unaffected by variations in the A.C. supply from which the unit works. A single valve is used, and the amplification is obtained mechanically from an extremely sensitive relay, using the relay system of Bristol's Instrument Company's "Pyromaster" recorder. In this system the relays cause self-balancing of the input of the single valve by energising a reversible motor in steps of fixed duration. The motor shaft is coupled to the slide wire of a potentiometer in the valve input circuit.

The glass electrode possesses a high internal resistance, which is about 100 megohms at the temperature of the measurement. Measuring circuits for use with glass electrodes, even in balanced systems, must therefore consume very small power, and the effects of the electrostatic field of the power mains must be avoided. Screening is thus essential, whilst at the same time the conductance of the input screened cable leads cannot be allowed to exceed 10^{-11} mhos.

Another unavoidable feature capable of producing undesirable hum effects arises from the fact that the water under test is effectively earthed at a point some small distance from the electrodes, and yet, since the conductivity of the water is extremely low, there may be appreciable resistance between this "earth" and the electrodes. The effects are successfully overcome in the present design by giving a high time constant to the input circuit formed by the glass electrode membrane resistance and the capacity of the input cable, and by reducing the efficiency of the grid circuit of the valve as a rectifier by suitable choice of operating potentials.

The loading of the electrode system during the interval between a change in pH and the final balance of the potentiometer, a matter of a few seconds, is due to the conductance of the input circuit, which is about 10^{-12} mhos, and the input conductance of the valve, which is between 10^{-11} mhos and 10^{-13} mhos. The steady value of the grid current is capable of affecting the accuracy of the record, should the resistance of the electrode system change. As, however, the input voltage due to grid current never exceeds 0·5 mV, such changes are negligible.

The overall accuracy of recording is

‖ M. Dole, *The Glass Electrode*, 1941, page 18; H. T. S. Britton, *Hydrogen Ions*, 1932, page 37.

¶ R. T. Hanlon, *Combustion*, 1939, 11, No. 1, 41–3.

estimated to be about 0·02 pH units, based on the pH value at the temperature of measurement. The pH value may of course vary slightly with temperature changes, but the system of temperature compensation cannot be made to take this effect into account since it does not arise from a single or constant combination of ionising components. The day-to-day stability of the recorder is shown by buffer solution checks to be within 0·01 pH.

Our thanks are due to the London Power Company, who have inspired the work, and to Marconi Instruments, Ltd., who developed and made the apparatus, and whose chief engineer, Mr. W. B. Bartley, kindly provided the description of the electrometer-recorder unit.

The Naval Campaign in the Mediterranean*

SURRENDER OF THE ITALIAN FLEET

THE surrender of the Italian fleet is one of the turning points in the war at sea. I propose briefly to review the naval campaign in the Mediterranean which has just concluded.

In September, 1939, the British and French fleets, together were so much superior to the German that there was no fear of our losing command of the seas, though it was expected that German U boats and commerce raiders would be very troublesome. In June, 1940, the position changed, almost overnight. The French fleet went out and the Italian came in. Our vital Middle East position seemed to be laid bare to the enemy, for at a time when we hourly expected invasion it was difficult to spare ships for the Mediterranean, and we had to accept in that sea a striking numerical inferiority.

Mussolini had available six battleships, two of them very modern, and nineteen cruisers, together with large numbers of destroyers and submarines, to which we could oppose four battleships, one aircraft carrier, and seven cruisers. The aerodromes all the way from Gibraltar to Egypt were now either actively hostile or passively unfriendly. The Sicilian Narrows would, we expected, be barred to surface ships by Axis bombers from Sicily and Sardinia. The Mediterranean was closed and reinforcements for the Middle East had to go *vid* the Cape of Good Hope.

The U-boat war, for which we could spare few escort vessels, was becoming more intense, and I ask you to keep in mind all the time this sombre background, which made reinforcement of the Meditarranean with destroyers and light craft so difficult and threatened to become so dangerous as to require us further to deplete our inadequate strength there.

Fortunately, we had in the Mediterranean a Commander-in-Chief of great spirit and resource, who proved fully equal to the enormous responsibility. "Because of our weakness," said Admiral Cunningham later, "our policy had to be one of aggressiveness and it paid handsome dividends."

If the Navy was to fulfil its functions of maintaining our lines of communications with Malta and Greece and destroying those of the enemy, some way must be found of reducing the Italian fleet. Many times did Admiral Cunningham put to sea with the hope of forcing a decisive action, but whenever contact was made the larger Italian forces retired, probably with the idea of drawing our heavy ships within range of shore-based aircraft. Consequently it was decided to attack them in harbour at Taranto by aircraft of the Fleet Air Arm. On November 11th, 1940, the nineteen "Swordfish" which took part in that remarkable attack succeeded in crippling the Italian battle fleet for a considerable period. From then until the conquest of Greece and Crete by the Germans and the arrival of the German Air Force in Sicily the Royal Navy controlled the Eastern Mediterranean, as the Italians found to their cost off Matapan.

Early in 1941 we suffered heavy losses in the operations off Crete, including severe damage to H.M.S. "Formidable," followed by a series of disasters which threatened our whole position at sea. His Majesty's ships "Illustrious" and "Formidable" were already out of action. H.M.S. "Hood" was sunk. The Army was driven back to the borders of Egypt, which made it impossible for the Royal Air Force or the Fleet Air Arm to give shore-based fighter cover against German aircraft operating from Crete over more than a very limited area, and our ships were constantly bombed whenever they exposed themselves outside that area.

The crisis in our fortunes was reached in November and December, 1941. On November 14th His Majesty's aircraft carrier "Ark Royal" was torpedoed and sunk, on the 20th the cruiser "Sydney" was sunk, on the 24th the cruiser "Dunedin," on the 25th the battleship "Barham." Then came the treacherous attack on Pearl Harbour, which temporarily crippled the American Pacific Fleet, followed almost immediately by the sinking of His Majesty's ships "Prince of Wales" and "Repulse." Shortly afterwards the battleships "Queen Elizabeth" and "Valiant" were severely damaged and the cruisers "Neptune" and "Galatea" sunk.

Thus within two months the American battle fleet covering the Pacific had been crippled, the British battle fleet covering Singapore and the Bay of Bengal had been sunk, the British battle fleet in the Eastern Mediterranean had been crippled, and the famous Force H had lost its invaluable aircraft carrier. Moreover, as the winter turned to spring the U-boat war reached its peak. Fortunately, the enemy did not know completely our precarious position, and for vital months we managed to conceal from him the damage to the "Queen Elizabeth" and "Valiant" and the sinking of the "Barham."

In the Mediterranean we had three cruisers left, yet our men fought on, working wonders.

Our greatest problem was Malta. That heroic island was holding out valiantly, but supplies were falling and at times could be measured in weeks. The loss of the airfields from El Alamein to Benghazi meant that little fighter protection could be given over the convoy routes and every convoy was in extreme danger from surface and air attack.

A small convoy with ammunition got through to Malta in January, but an attempt to get another one through in February had to be abandoned.

In March Admiral Vian, in command of the Fighting Fifteenth Cruiser Squadron, was sent to make another attempt. He met the Italian fleet and the Luftwaffe, and his battle with them is one of the most brilliant in our naval history.

The enemy came south in two forces, the first of one 8in. and three 6in. cruisers, the second of the battleship "Littorio," two 8in. and three 6in. cruisers with attendant destroyers. Admiral Vian's plan was to lay a smoke screen in front of the convoy, attacking with torpedoes under its cover if the enemy attempted to break through. Favoured by a strong south-easterly wind, this plan enabled him to drive off the first section, but whilst he was searching with his cruisers for two of the enemy's damaged ships, the "Littorio," whose presence until then had been unsuspected, bore down at high speed on the convoy. Without hesitation the destroyers "Sikh," "Havoc," "Lively," and "Hero" attacked. Although straddled continuously by 15in. shells, they held off the threat to the convoy until the cruisers returned. Then the 14th Destroyer Flotilla, "Kelvin," "Kipling," "Kingston," and "Legion," led by "Jervis," with the cruisers "Euralyus" and "Cleopatra" (Admiral Vian's own ship) in support, went in to attack. The "Littorio" was hit by a torpedo and by gunfire and a cruiser was seriously damaged. The Italian forces turned for home, but before they got there the submarine "Urge" picked off the damaged cruiser. Under ceaseless air attacks and in the teeth of a gale the convoy steamed on. One of the four supply ships was sunk 10 miles south of Malta, and another, the "Breconshire," was hit when almost home. She crawled into a bay to the southward of the Grand Harbour, but was again hit and sank. The other two were bombed in harbour, but most of their cargo was saved.

In June Admiral Vian was again on the Malta run. Two battleships of the "Littorio" class, four cruisers, and eight destroyers barred his passage. Admiral Vian took avoiding action, while air striking forces from Malta and the Western Desert attacked. One of our submarines saw a 10,000-ton cruiser stopped and on fire and sank her by torpedo. Other damage was inflicted on the enemy by the air attacks, and one enemy battleship was hit by a torpedo. Despite these successes, the convoy did not get through, for extra steaming had used up so much fuel that course had to be set for Alexandria. However, a convoy had been simultaneously passed from the Western Mediterranean and in the face of incessant attacks by the enemy air forces some of the ships reached Malta.

The next convoy to Malta was in August, this time from Gibraltar, and was supported by aircraft carriers. Although H.M.S. "Eagle" was lost at the beginning of the operation, the Fleet Air Arm worked with great success and shot down no less than fifty of the enemy. In the Sicilian Narrows the enemy developed the very heaviest attacks both by aircraft and by E boats, and our losses were not light, five ships only reaching Malta. But Malta was saved by the supplies in those ships, which lasted until the victory of El Alamein and the reconquest of Cyrenaica made it possible to give air support to convoys from the East.

During all this time Malta had to be supplied with aircraft to defend her against the Luftwaffe and to help to protect the relief convoys. The range of fighters is limited, and they had to be carried in aircraft carriers to within a short distance of the island. Over 700 aircraft were transported by His Majesty's carriers in this way and 111 by a United States carrier.

Offensive action against Rommel's supply lines was carried on mainly by His Majesty's submarines and aircraft of the Fleet Air Arm and the R.A.F., though from time to time cruisers and destroyer forces were made available for night operations in the Sicilian Narrows. Considerable success was obtained and the combined sinkings played a vital part in Rommel's destruction. His Majesty's submarines sank a total of 1,335,000 tons. These results are the more remarkable, because the Mediterranean is perhaps the most difficult area in the world for successful submarine operations; forty-one of our submarines were lost. In addition, the Fleet Air Arm operating from carriers from Malta and from aerodromes in the Western Desert accounted for another 410,000 tons. Perhaps the most spectacular action by surface ships was the elimination of an enemy convoy of ten merchant ships and two destroyers by the cruisers "Aurora" and "Penelope" with the destroyers "Lance" and "Lively."

The advance of the Army from El Alamein and the landing of the Anglo-American expedition in North Africa completely revolutionised the situation. Malta was relieved and became an advanced offensive base and from November onwards our grip on the inland sea has been steadily tightening. No large-scale enemy evacuation from Tunisia was allowed; there was little interference with our expedition to Sicily, and by the capture of Sicily the Italian fleet was irrevocably divided, one part at Taranto the other at Spezia. Nevertheless, so long as these battleships and cruisers remained in enemy ports, they were a potential menace

* From a broadcast by Mr. A. V. Alexander, First Lord of the Admiralty, on the evening of September 16th.

to the security of our convoys and to offensive expeditions, and battleships and aircraft carrier cover had always to be provided lest they should perchance come out.

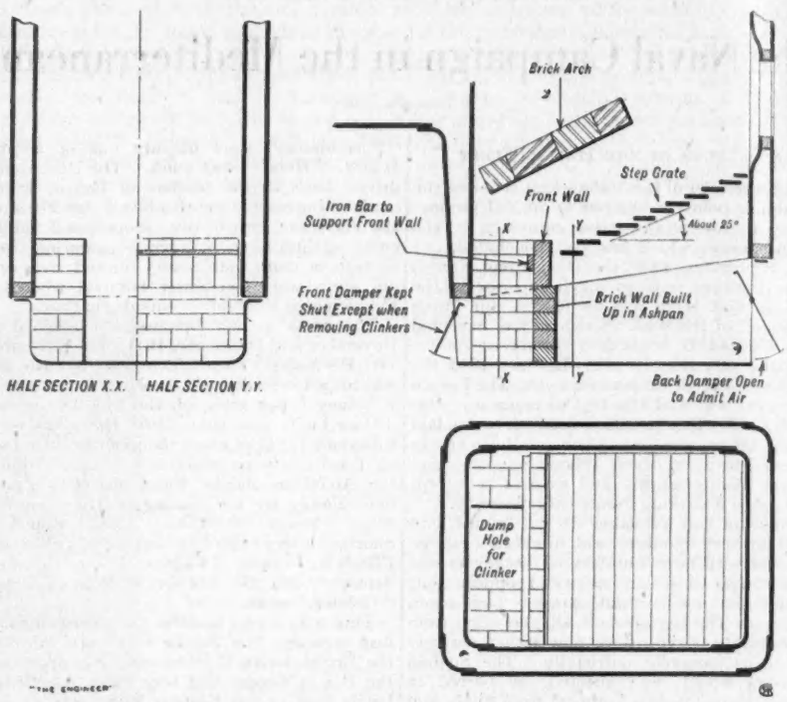
This very brief survey reveals how much the nation owes to all the officers and ships' companies of the Mediterranean Fleet. Admiral of the Fleet Sir Andrew Cunningham, by his resolute leadership and skill, has gained a notable place in our great naval history. He was grandly supported by Flag Officers like Sir John Tovey, Sir James Somerville, Sir Neville Syfret, and Admirals Lyster, Vian, Burrough, Willis, and many others; but, above all, by the general loyalty and enduring courage of thousands of officers and men in the ships and in the naval aircraft, many of them almost straight from the office, factory, and school. His Majesty the King has voiced the nation's thanks. But the Royal Navy would be the first to pay its tribute to the magnificent help which it has received from their comrades in the Merchant Navy, who have reached the highest level of bravery and endurance in all our history, from the gallant pilots and crews of the Royal Air Force, and the great campaigns of the Desert Army.

How the scene has changed from 1941! The balance of sea power has been entirely altered. Not only is the Italian fleet out of action, but our naval forces are gallantly supported by our American friends. As I speak, they, with us, are supporting our land and air forces in pounding the Germans in Italy. The severity of the battle there must be a warning that our struggle against the Nazi monster will be fierce and may be long. There is no possible room for any easing off in any part of our war effort. The Germans must be completely defeated, and as soon as possible. Every bit of extra national effort at this time will shorten the war in Europe, bring speedier relief to the gallant armies of Russia, and enable us to concentrate such strength in the Far East with the U.S.A. forces as will smash the Japanese terror and bring succour to China. These are huge tasks. We have come through dreadful periods in a manner which would have been impossible without the splendid work and production of our people at home. With the same spirit of devotion we can meet these great tasks with confidence and with the unmistakable feeling that "Hitherto hath the Lord helped us."

Smoke-Box Char as Boiler Fuel

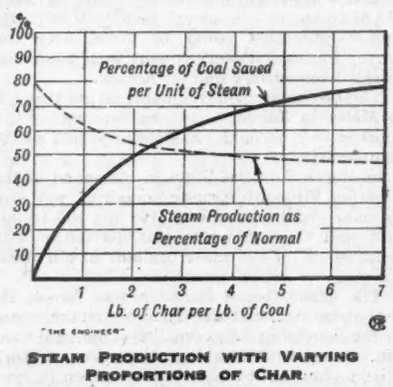
THE char removed from the smoke-box of a locomotive, while very small and little more than dust, still contains an appreciable quantity of thermal units and is therefore capable of being utilised to produce steam. In the past the practice on the L.M.S. has been to send it in considerable quantities to the company's power stations, where it is burnt in the chain-grate boilers mixed with coal. During the present emergency greater care has been exercised in collecting all the available char at the running sheds, and consequently larger quantities have become available. Also, it was considered desirable to explore methods by which the char could be burnt locally at the places where it is collected, and thus save the rail transport necessary to send it to the power stations. There are, up and down the line, stationary locomotive type boilers which are used for various purposes; for example, for preheating trains, and attention was therefore given to the possibility of burning char in these boilers.

Unfortunately, there are certain difficulties in this respect. If char is fed on to an ordinary grate a large percentage drops through the fire-bars and is lost. Moreover, the char contains a large amount of incombustible matter, which forms clinker, and the removal of this clinker at frequent intervals, without impairing the steam production during the process of cleaning the fire, is very difficult. For these reasons the type of grate shown in the accompanying engraving has been designed. The fire-bars are arranged horizontally, like a flight of steps, so that the char cannot drop through the bars. To facilitate cleaning the fire, a fire-brick wall is provided towards the front of the fire-box, the wall dividing the ashpan into two compartments. The back portion is open to the atmosphere to admit air to the grate through the back damper, but the front portion is completely shut off from the atmosphere by the front damper and is only used as a receptacle for clinker. To clean the fire the clinker is pushed down the steps by means of a slice and lifted over the front wall into the dump hole, from which it is removed at intervals through the front damper. The slope of the step grate makes the removal of the clinker an easy matter.



FIRE-BOX WITH STEP GRATE FOR BURNING CHAR OR COAL SLACK

The grate is cleaned part at a time; for example, first the centre third and then the right-hand and left-hand sides. After cleaning off the clinker the fire-bars are practically bare, and if fresh char is put on it takes some time to ignite. It is therefore the practice, after cleaning a portion of the grate, to put in one or two shovelfuls of small coal, which ignites much more readily. When this is well alight firing with char exclusively is resumed.



STEAM PRODUCTION WITH VARYING PROPORTIONS OF CHAR

It has been found that each pound of char will evaporate about 4·791 lb. of water, from and at 212 deg. The total quantity of steam produced in a given time when burning char is, of course, considerably less than would be produced by the same boiler when burning coal, on account of the lower calorific value of the char, the fact that the draught has to be limited to a vacuum of about ½in. of water in the smoke-box—as a greater draught would lift the char off the grate—and also because the grate area has been reduced by the provision of the front wall and dump hole. For this reason it will be necessary in most cases to burn a certain amount of coal in addition to the char.

The graph reproduced herewith shows the effect of varying the proportion of char and coal on the steam production and on the amount of coal saved. Whatever the percentage of coal used, the coal is not mixed with the char, but is put on the grate after removing the clinker. By this method the coal has burnt away before the next cleaning is necessary, and this avoids the possibility of good coal being removed with the clinker.

Apart from its original purpose of enabling char to be burnt, this type of grate has been found successful in enabling loco-type stationary boilers to be fired with coal slack instead of with lump coal. The difficulties of burning slack are the same, although in a lesser degree to those when burning char, *i.e.*, there is the tendency for the small coal to fall through the normal type of grate, while many types of slack coal produce a considerable amount of clinker. The step grate and dump hole for the clinker enable these troubles to be overcome, and it has been found in one particular test, using ¾in. slack coal of low grade, that the steam production was about 95 per cent. of that normally produced when using a moderate quality of lump coal. This application should be of value, as not only is slack coal cheaper, but it is understood that at the present time there is a greater shortage of lump coal than there is of slack, so that any such extended use of slack is a definite advantage from the national point of view.

SOUTH AFRICA MAKES SUGAR MACHINERY.—The fact that sugar machinery for use all over South Africa is being manufactured and repaired in Durban has been revealed by the South African Federation of Engineering and Metallurgical Associations. Sugar mill rolls of from 5 to 19 tons have been made in Durban for manufacturers on the Zambesi and the Limpopo rivers, and inquiries have been received from as far afield as Angola. The stoppage of supplies of sugar from the Netherlands East Indies and other Far Eastern sources has increased the importance of South Africa's sugar industry, not only in that country, but to the United Nations as a whole.

The Fuel Efficiency Committee

INTRODUCTION

MR. D. R. GRENFELL, the then Secretary for Mines, set up a Fuel Efficiency Committee in September, 1941, under the chairmanship of Dr. E. S. Grumell.

When the Ministry of Fuel was established, the Committee was reconstituted and became fully representative of all fuels, a desideratum which has been maintained in the composition of the Regional Committees which will be described later. This has meant that a fully co-ordinated campaign could be undertaken, ensuring that economies in the use of one particular fuel did not merely mean an increase in the use of an alternative fuel.

The Committee's work has been greatly helped by the personal interest of both Mr. Grenfell, when Secretary for Mines, and Major Lloyd George, the present Minister of Fuel and Power. Just before Christmas, 1941, the Minister addressed a personal letter to the managing directors of all large firms stressing the importance of fuel economy and urging them to appoint "Fuel Watchers" (for whom badges are now available) to be continuously on the alert for waste of fuel. This letter was accompanied by a Bulletin describing the many ways in which these watchers could help the Ministry's campaign.

A PLANNED CAMPAIGN

The Fuel Efficiency Committee's campaign to reduce waste of fuel has been carefully planned and organised so as to enable an approach to be made to industry from several directions. The lines along which this approach has been made may be summarised briefly as follows :—

(1) The provision of a direct combustion engineering advice service through qualified experts attached to the Ministry's Regional Offices and through the establishment of Regional Fuel Efficiency Committees with investigating panels of engineers to visit and advise industrial firms on steam-raising problems.

(2) The preparation and issue of technical bulletins dealing with various problems on steam raising and the use of heat and power in the factory.

(3) The training in fuel efficiency of management and boiler-house staff by lectures and demonstrations at nearly one hundred centres throughout the country.

(4) Inducing trade and research organisations to set up Fuel Efficiency Committees within each main group of industry to examine their special problems in the use of fuel, including collaboration with the major fuel-consuming industries, such as the railways, collieries, gas and electricity undertakings, iron and steel industry, and coke producers.

It has naturally taken time for these four elements of the campaign to develop fully; nor were they all launched at the same time, and they are therefore at varying stages of development. There is no doubt that as a result of their impact on industry very substantial economies in the use of all fuels are being achieved.

In the following review each phase of the campaign will be dealt with in turn, but it should be borne in mind that they interlock and should be regarded as a "combined operations" attack.

THE MINISTRY'S ADVISORY ENGINEERS

At the time the Fuel Efficiency Committee was appointed the Coal Utilisation Joint Council placed the whole-time services of its combustion engineers at the disposal of the Mines Department.

The Ministry has now increased its staff to forty-five combustion engineers. One of their first tasks lay in demonstrating how to make the best use of unfamiliar or low-grade coals. They also advise the Ministry's Regional Coal Officers on the suitability of fuels for various types of appliances. By personal contact they ensure that the maximum output is being obtained from the coal supplied to the firms they visit.

A recent addition has been the engagement of four stoker-demonstrators, who visit works and give demonstrations and talks to groups of operatives on the actual firing floor. The only limitation in all this work is the supply of suitable personnel.

REGIONAL FUEL EFFICIENCY COMMITTEES

The direction in which the campaign has progressed most rapidly of recent months has been the extension of the system of inspection of individual factories by qualified combustion engineers. The Controllers in each region have recruited the part-time voluntary assistance of many experts engaged in industry, and over 660 are now supplementing the work of the Ministry's own engineers.

This work is co-ordinated through Regional Fuel Efficiency Committees to which the groups of experts, or "investigating panels," as they are known, report. The credit for initiating this important development must go to the Deputy Fuel and Power Controller for North Wales, who set up a local organisation on these lines in January, 1942. Every single factory in his area has now been visited, and follow-up calls have been made to see that the Committee's recommendations are carried out.

This scheme has now been extended to every region and a recent summary of the work of all the panels shows that 10,000 factories have been visited with an aggregate coal consumption of thirty-three million tons a year. If their recommendations are carried out—and they intend to see that they are—the resulting savings should amount to about 10 per cent. of the annual consumption. These results can be achieved by paying proper attention to operation and maintenance without, save on rare occasions, installing new plant, which is difficult to secure in wartime. The Committee's attention is not confined to securing economy in coal; the assistance of experts in the use of gas, electricity, and fuel oil has been enlisted with considerable effect.

The Regional Committees are keeping in close touch with industrial trade and research organisations in each area. Many industries in which the practice of fuel efficiency has received particular attention have been most helpful in allowing their experts to serve on the investigating panels, in addition to the co-operative work on fuel which they are already doing within their own trade.

The variety of the work done by both the Ministry's engineers and the voluntary panels make it difficult to describe in general terms. A few examples taken from their reports, however, will show how their activities are saving fuel.

A well-known engineering company engaged on work for the Admiralty complained that it was impossible for them to accept a 7½ per cent. fuel cut without loss in production. An inspection of the boiler plant was made by the Ministry's engineer, who reported that two water-tube boilers were in use where one would do, simply because the fireman thought it was easier work and the chief engineer did not trouble to inquire why. The total steam load was satisfactorily carried on one boiler with an approximate saving of 8 tons of coal per week.

A request was received for inspection and advice from a section of the laundry trade in the Midlands. After discussion one laundry, reputed to be the most efficient in the district, was selected and thoroughly inspected by our engineer, who recommended overhaul of boiler settings and brickwork, attention to air leakage in dampers and intakes to drying machines, overhaul of all faulty steam traps, lagging exposed steam and hot water services, supervision of operations inside the laundry itself. The superintendent later informed the engineer that although improvements to the boiler plant had not quite been completed, they had successfully modified the sequence of operations in the laundry with the result that they were saving something like 15 tons of coal per week.

The Ministry's engineers naturally devote most attention to plants which are known to be working at low efficiency and which offer scope for relatively large saving in fuel. An interesting exception is the case of a northern textile mill equipped with up-to-date Lancashire boiler plant, economiser, and superheater supplying steam to a uniflow engine, back-pressure steam being utilised for process heating. During an inspection it was observed that the temperature rise through the economiser was only 30 deg. Fah., and investigation during a shut-down period revealed that the dampers failed to prevent a large proportion of the flue gases by-passing the economiser and escaping direct to the chimney. Making the dampers gas-tight meant a 7 per cent. fuel saving on a plant which was considered to be an example to the trade.

An excellent example of gas savings effected by a single firm is offered in the case of a large glass manufacturer. Modifications were carried out on the various plants in their gas-fired finishing processes involving closer adjustment of the position and angles of burners, and the resulting elimination of certain other burners. Alterations were also made in the gas ports to save compressed air. The introduction of refractory side muffles where one row of burners had been dispensed with and the placing of refractory shields at the top and bottom of each burner enabled more complete and better firing finishing. These with other minor modifications resulted in a reduction of gas consumption from 12,600 cubic feet per hour to 3900 cubic feet per hour.

FUEL EFFICIENCY BULLETINS AND THE WORK OF THE TECHNICAL SUB-COMMITTEE

A Technical Sub-Committee of Dr. Grumell's main Committee has been in almost continuous session to deal with practical problems of industrial steam production and consumption. The Sub-Committee has acted in an advisory capacity on all matters under these wide headings, but perhaps the most important of its functions has been the preparation of technical literature for circulation to industry in the form of *Fuel Efficiency Bulletins*. The first of these, on "Steam Production and Consumption," formed the basis of the preliminary approach to trade and research organisations and was accompanied by a letter from the Chairman urging managements to focus attention on all questions of fuel economy.

Some twenty-five *Bulletins* have been prepared and issued, covering a wide variety of subjects, ranging from efficient steam production and utilisation to the organisation of fuel watchers, and the measurement and assessment of fuel savings.

The Committee's *Bulletins* have been widely circulated throughout industry, and it is gratifying to record that there have been many letters and appreciative reports on their helpfulness. There have naturally been criticisms on various technical points, but this is to be expected in view of the urgency with which these emergency documents were prepared and issued. Well-informed and constructive criticism is welcomed at all times, as it is only by this means that the weak spots of the campaign can be ascertained and strengthened.

In dealing with the problems on the efficient use of fuel, the Technical Sub-Committee has had the advantage of being able to refer matters requiring research to the British Coal Utilisation Research Association, and to the Fuel Research Station of the Department of Scientific and Industrial Research, as well as to other research institutions. Close liaison has been maintained with various professional societies, and in particular the Technical Committee of the Institute of Fuel has been most helpful in advising on many of the problems investigated.

THE FUEL EFFICIENCY TRAINING SCHEME

One of the first decisions of the Fuel Efficiency Committee was to establish a scheme of training for both management and boiler-house staff, to cover not only steam raising, but also the operation of gas producers, furnaces, and the use of heat for process work. A small

Education Sub-Committee was formed and in collaboration with the Board of Education free experimental courses of lectures for management staff and lectures, supplemented by demonstrations for boiler-house staff, were arranged at Manchester, Bolton, St. Helens, Birmingham, Coventry, Wolverhampton, and Stoke-on-Trent. The response to the announcement of these courses exceeded all expectations; in Manchester alone there were 447 applications for the first courses.

They started early in January, 1942, and were held during the afternoons in working hours. Industry readily collaborated by allowing their employees time off to attend the course and by paying their travelling expenses. The success of this experiment confirmed that there was an urgent need for instruction of this nature, and accordingly it was decided to extend the scheme as rapidly as possible to other industrial centres. Some twenty-eight colleges and universities were operating under the scheme by the end of April, 1942. Nearly 100 colleges and universities have now operated under this scheme and courses are proposed at a further forty centres. The total enrolments up to May, 1943, exceed 11,200. Plans for the forthcoming season include, in addition to repetitions of previous courses, new lectures on steam utilisation and on specialised subjects called for in the particular regions.

A two-reel film, "Boiler-house Practice," has been produced, and is now being distributed. The Ministry of Information are showing it throughout the country in their mobile units, and the Ministry of Supply are also including it in their factory film service. This film is proving a very valuable adjunct to firing demonstrations and lectures, besides serving as a stimulus to managements to take an interest in fuel efficiency. Its reception has been extremely favourable, and other films are under consideration. Copies of the boiler-house film have been sent to the American Board of Mines.

Mention should be made of the efforts of individual industries in providing specialised courses of instruction relating to their particular problems. The glass industry is to be congratulated on its most effective series of lectures, and the pottery industry is also running special classes relating to the efficient use of fuel in kiln firing; the canning industry has asked for a training centre in the Eastern counties, where its employees can receive instruction in the economical use of steam.

Industry Fuel Efficiency Committees

In its approach to industry the Fuel Efficiency Committee has interviewed the representatives of seventy-six trade and research associations on the subject of fuel efficiency. The object of these meetings has been to enlist the help of organised groups of manufacturers by explaining the vital urgency and importance of the Ministry's fuel efficiency campaign and to urge the setting up of Fuel Efficiency Committees within each industry. The response has been most encouraging. In all cases an undertaking has been given to set up a Fuel Efficiency Committee, and this has been implemented with varying degrees of energy.

Industry Fuel Efficiency Committees are assisting the economy drive in the following ways:—

(*a*) By providing a means of interesting managements in the urgency of the problem.

(*b*) By providing through their trade Press and other literature a medium for propaganda on fuel economy presented in the way most appropriate to the particular problems of an industry.

(*c*) By obtaining an indication of any firms in an industry that use fuel inefficiently, *e.g.*, through the analysis of replies to questionnaires.

(*d*) By examining the possibilities of saving fuel by modifications to plant or of the actual processes of manufacture.

(*e*) By securing, wherever practicable, the adoption throughout the industry of new methods of saving fuel that have been developed by particular firms.

(*f*) By encouraging the establishment in each works of an active and efficient system of fuel watchers.

(*g*) By encouraging technicians to join the regional panels.

A two-day conference on the efficient use of steam, heat, and power was held in London on May 12th and 13th. It was opened by the Minister, Major Lloyd George, and was attended by 800 delegates from all parts of the country. Prominent industrialists described both the methods and the results of their fuel economy efforts, and the interchange of ideas and experiences proved extremely valuable. This conference and other smaller ones that have been held brought out the value of contact between industries in the promotion of fuel efficiency, and many striking instances of fuel savings were reported. Some of the methods used, although standard practice in some industries, were evidently quite unknown in others.

The following examples give some indication of the work which was undertaken by the Committees up to the end of 1942:—

In the cement industry instructions which were given to grind slightly coarser have resulted in the saving of up to four units of electricity per ton of cement in some of the larger works.

The Cocoa and Chocolate (Wartime) Association has appointed a responsible member of their Fuel Economy Committee, or member of the Association, to be responsible for each area in which their factories are located. Members of the industry have been advised of the savings that can be made by turning off process equipment when not in use. Posters and educational matter are circulated from time to time. The Fuel Efficiency Committee of the glass industry has formed a panel of honorary lecturers, who have undertaken classes in their own and in neighbouring works. Industrial experiments using low-grade coal have been carried out and there is in preparation a scheme for the analysis of producer coal suitable for glassworks' laboratories.

The fuel efficiency officer appointed by the hosiery industry has visited ninety-three firms for the purpose of conducting preliminary surveys and recommendations have been made in sixty-one instances. He reports that in one firm 30 per cent. saving in fuel resulted from carefully supervising the operation of a manually controlled heating system, coupled with intelligent firing of the boiler plant.

The laundry industry has carried out a technical survey of boiler plant conditions in over 1000 firms. It is anticipated that some improvement in plant operation could be effected in about 300 laundries by putting into practice simple ideas which will not involve the installation of extensive plant.

In order to supplement the technical *Bulletins* issued by the Ministry the Fuel Economy Committee of the papermaking industry has issued a technical memorandum to all their members and to certain other industries. A series of similar publications is being undertaken. The British Sugar Refiners' Association has surveyed all their refineries and has reported substantial economies by individual firms. It estimates a total saving of 113 tons per week to date, with a prospective additional 270 tons when contemplated improvements have been carried out.

The above examples do not represent by any means the total sum of activities of the industries mentioned, nor are those industries the only ones which are taking effective action. It is hoped that close contact between the Fuel Efficiency Committees of these and other industries will lead to valuable interchange of practical ideas.

Several industrial groups are appointing full-time fuel efficiency officers. This is a development which the Ministry is anxious to encourage. It is felt that in the past many industries, which even in peacetime would find it well worth while to employ a technical expert, did not recognise the financial benefits to its member firms of reducing manufacturing costs through fuel savings.

The Major Consumers

Included among those industries which are the largest consumers of coal are the fuel-producing interests themselves—collieries, gasworks, electricity stations, and coke oven plants. These, together with the railways and the iron and steel industry, accounted in peacetime for nearly 45 per cent. of our total home consumption of coal. It was natural, therefore, that the Fuel Efficiency Committee looked to them, not only for substantial fuel economies in aggregate, but also for assistance from their technical experts. Each has taken vigorous action in support of the campaign. In summarising their activities it will be seen that so far as the fuel industries are concerned their objective has been twofold—to economise in fuel consumption and to increase output.

The coal industry has formed a joint committee with the Fuel Efficiency Committee and, in addition to dealing with problems of coal preparation and washing, is investigating the possibility of the increased use of slurry and other unsaleable fuel on their boilers in order to release other coal for the market. District Committees have been set up in the coalfields and, in collaboration with the Regional Fuel Efficiency Committees, much is already being done in this direction. Boiler efficiency is being improved, resulting in a direct addition to coal available for general industry. One colliery in North Wales which was accumulating a large slurry pond reports that this reservoir of previously unwanted fuel has now been burned on its own plant and that the current "make" of slurry is immediately consumed.

The Directorate of Gas Supply set up a Consultative Committee, which is making a critical survey to ensure that the best use is being made of coal, coke, and oil for gas manufacture. Comprehensive notes have been sent round to gas undertakings indicating the points that should be watched to improve the operation of plant. Regional Gas Advisory Boards have been set up and a fuel economy campaign within the gas industry is being conducted through this organisation.

On the gas utilisation side the industrial Gas centres and local undertakings have co-operated with the Ministry's Regional Committees in providing a technical advice service readily available to every industrial gas consumer.

A Fuel Efficiency Committee has been set up by the British Hard Coke Association, in collaboration with the Ministry of Fuel and Power, to examine the amount of fuel used for heating coke ovens and the general questions of the efficiency of steam raising and fuel economy at coking plants. The Committee is fully representative of the industry and includes representatives of the Coke Oven Managers' Association, together with technicians drawn from the various regions in which the industry is located.

Electricity power stations have for long been regarded as most efficient users of coal. This has not prevented the industry, however, from overhauling its individual units to see what more could be done. A problem, which is largely outside the power of generating stations to control, but which has an important bearing on fuel economy, is the incidence of the peak load of consumption. Propaganda is being used, both by the Ministry and by the electricity industry itself, to induce both domestic and industrial users to shift their consumption away from the peak period of 8 a.m. to 1 p.m. wherever possible. One of the largest undertakings in the North-West has succeeded in transferring no less than 7300 kW from the morning to the afternoon load, largely through the co-operation of local industry, refrigerating firms in particular.

By arrangement with the Railway Executive Committee representatives of the four main line railway companies and the London Passenger Transport Board have met the Ministry's Fuel Efficiency Committee and a railways fuel efficiency committee has been established. Considerable attention is being paid to locomotive firing, and lectures and practical demonstrations for firemen are being undertaken in at least one of the railway companies. The use of smoke-box char for heating purposes is being extended wherever possible in railway establishments. Fuel watchers have been appointed and a careful check is made to see that their recommendations are carried out in workshops, yards, stations, and offices. The enormous consumption of fuel by the railways for other purposes than loco-

motives is often overlooked. Electricity and gas are used to a large extent, particularly, of course, the former, for electrified sections of the line. One company estimates that it is saving 12,000 electric units a day on one particular service alone by allowing trains to coast downhill and when approaching stops. Salvaging coal spilled from loaded wagons in marshalling yards is also receiving close attention.

By reason of the importance of fuel costs in the manufacture of iron and steel, fuel efficiency has for long been one of the main preoccupations of that industry. Nevertheless, there has been an immediate response to the call for even greater economies, and as a result of the work undertaken by committees established by the Iron and Steel Federation in each of its main regions the industry is consuming 5 per cent. to 7½ per cent. less fuel than before. These local committees have worked in close accord with the Regional Committees of the Ministry. Special mention should be made of a most valuable report on fuel efficiency prepared by the Sheffield section of the industry. Some enlightening examples of savings actually made were quoted, and it was recorded that it would not be unreasonable to hope that an overall fuel saving of some 10 per cent. could be achieved by the industry.

South African Engineering Notes

(By our South African Correspondent)

CAPE TOWN, June 28th.

Electrical Goods Made in South Africa

ELECTRICAL manufacturers in the Union could meet all the essential requirements of the building trade if only orders were placed on a sufficiently large scale, according to the Chairman of the Electrical Engineers' Association, in an interview in Johannesburg. The average commercial firm was not prepared to spend thousands of pounds on jigs and set-ups to execute orders for small quantities, but would undertake production if they were assured of orders on a scale commensurate with the country's needs. On this basis many electrical articles in short supply could be manufactured. Besides iron-clad switch fuses and motors, local manufacturers are turning out three-pin plugs and sockets, fuses, and fuse gear, lighting fittings, cut-outs, contactors, switch fuses, and other items. All the materials needed for these products are available in South Africa.

South Africa to Produce Armour Plating

The Van der Bijl steel works at Vereeniging, in the Transvaal, construction of which began nine months ago, are expected to be producing armour plating in August. Heavy plate machinery is being installed and such rapid progress made that it is already nearly completed. It is this plant which is expected to produce the armour within three months from now. Near the new works is the site of the Van der Bijl township, which eventually will be inhabited by 100,000 men, women, and children. Work is going ahead on a railway track leading to a bay which will be the largest bay in South Africa.

Electric Motor Built in South Africa

The largest electric motor so far made in South Africa has just been completed. The motor, whose rating is 2250 H.P., was built by the employees of a Rand gold mine and a Johannesburg firm of electrical engineers. It is intended to dewater the underground workings of the mine. It took six months to make and has been built by South African labour and to purely South African design.

Industrial Boom Expected

The extraordinary expansion of industry in South Africa has had a profound effect on the military supply position, not only in Southern Africa, but also in the Middle East and other theatres of war. So well has the Union adapted itself in the engineering field to the requirements of defence, that competent observers have seen the outline of a great industrial development after the war, provided the consumer in this country will abandon his import fetish and not decline to take the South African-made article while he can obtain imported goods. Many firms now engaged in providing transport vehicles and other war requisites can, when peacetime comes, at once convert their plants to the manufacture of other lines if they can get the orders.

By up-to-date methods brought into use by executives who have studied large-scale production in America and Britain, these concerns are making a remarkable contribution to Union industrial progress. These firms are among many now building war materials who are faced with a vast post-war problem. After the war they will have no raw material problem, and it is pointed out that the steel industry here will be looking to engineering firms to keep up manufacture in order that the State steel establishment and other basic institutions may maintain their present rate of output. Industrialists conceive a great expansion of transport in South Africa when war ceases, and they believe that the State and the municipalities can give the lead by placing locally orders which they are in the habit of sending oversea. They consider that in this way the country will be helping to solve not only its returned soldier problem, but that which may be created by the influx of the post-war settler.

Oil-Bearing Shale in the Cape

Promising surface indications of oil-bearing shale have been discovered at Kaalkop, near Graaff-Reinet, and after a survey the Government Geological Department intends to bore for petroleum. Tenders have been invited for boring. The local magistrate has been appointed Commissioner.

South African Shipbuilding

That Durban will before long become the centre of a South African shipbuilding industry is the considered opinion of Mr. Frank Acutt. At a recent meeting at Durban Mr. Acutt said: "I regard it as most important that a country such as ours, which depends to a great extent on shipping for the maintenance of its trade, should have such an industry, and I am glad to be able to announce that this industry is now taking shape. The Government got out experts to advise them on the matter, and the experts selected the land at the head of the bay as the most suitable place for a shipbuilding industry." Mr. Acutt also said that this project would provide work for "hundreds of thousands."

Ultra-Deep Mining

The question of the feasibility of carrying out mining operations down to the estimated maximum depth of 13,000ft. has been frequently discussed since 1939, and it has been pointed out that the problem of financing the ultra-deep level shaft system required for this purpose is virtually insuperable without Government assistance. The project becomes less practicable as each year goes by, but the position must be regarded as a matter of grave public interest, because of the important bearing it has on the whole question of ultra-deep level mining on the Witwatersrand. In these circumstances it is satisfactory to note that it was recently announced by the Minister of Mines that a commission is to be appointed to go into the whole question in the near future.

Benefits of Air Cooling

Several important gold mines have found that the depths they have now reached underground are so great as seriously to decrease the workmen's efficiency owing to the great heat they have to work in. They have therefore installed special air cooling plants, which are now functioning. The reports on the effects of these plants have been in all cases satisfactory and will no doubt cause other mines approaching these great depths to consider the instalment of these air cooling plants and profit by the experiences of those who have already installed them. As an example of the benefits which accrue from air cooling in the gold mines, the experience of the City Deep may be quoted, and it is taken haphazard from a number of others. On this mine the net expenditure on capital account for the year was £91,731. The bulk of this expenditure was in connection with the air cooling plant at No. 4 shaft, which is now in operation. This plant, which is situated on the surface at No. 4 shaft, is passing into the mine approximately 280,000 cubic feet of air per minute, the temperature of which is being maintained at 36 deg. Fah., and considerable benefits have already been obtained in the workings served by the shaft. The temperature of the air on the 41st level at 4B shaft, at a vertical depth of 8230ft., which was 83 deg. Fah. wet bulb in December last, has now been reduced to 72 deg. Fah. wet bulb. Further improvements are expected with the continued working of the plant as the intake airways gradually cool down, due to the passage of the cooler air.

Vereeniging's Industrial Future

In view of the building of a great steel works at Vereeniging, in the Transvaal, and of the large important works already established there and others now contemplated to be built there, now that an ample supply of steel can be guaranteed in the near future, the town of Vereeniging is looking forward with confidence to becoming one of the largest industrial centres in the Union. So confident is the town that it is preparing plans for the building of a new works city. A site has already been selected for the new city. The new steel works being erected by the South African Iron and Steel Industrial Corporation is going on apace now, though there has been much delay in getting plant and machinery from the countries—America and Britain—which are executing most of the contracts. However, there has been a considerable speeding up and much of the material has arrived or is on the way. Quite recently two of the heaviest lifts ever made in South Africa were tackled, when two massive steel castings destined for the new steel works and weighing 100 tons each were landed and then trucked to Vereeniging. Both lifts were made by the 80-ton crane, whose designers allowed for a 25 per cent. overload to be taken with safety. The two pieces of machinery constitute the heaviest single truckload ever to be taken by the South African Railways. A special wagon had to be constructed for the purpose. It is mounted on sixteen wheels. A speed limit of 15 miles an hour was set for the load, which travelled only by day.

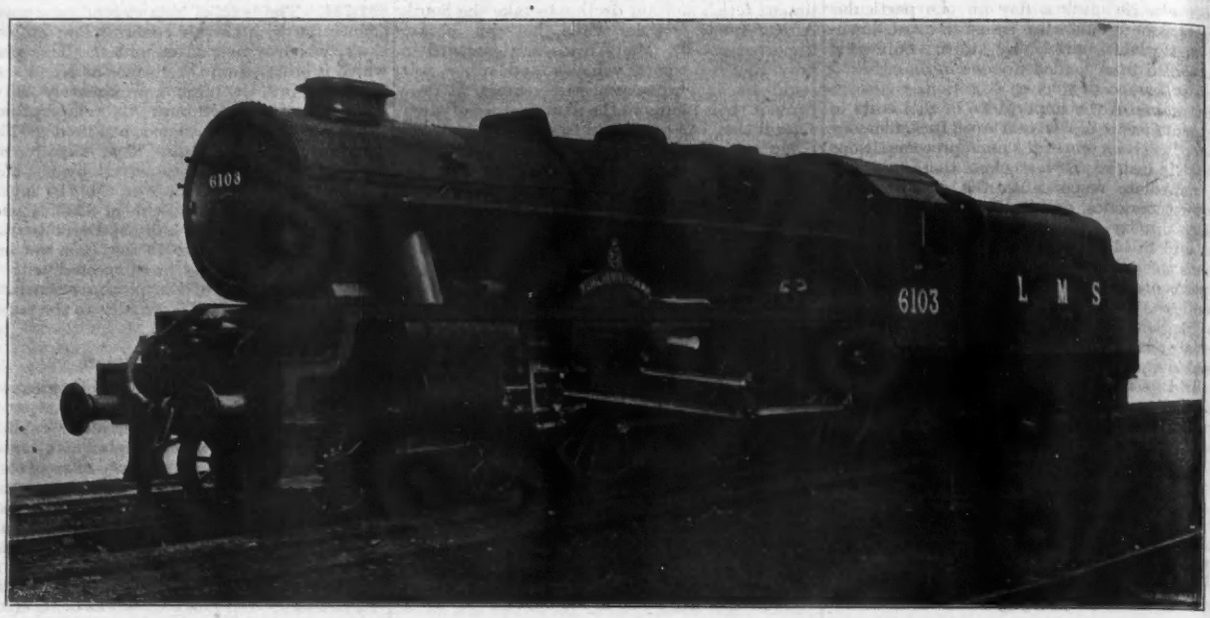
Road Transport

The chairman of the National Road Transportation states that road transport in the Union is being threatened with disruption owing to a shortage of motor vehicles, spares, oil, rubber, and petrol. The country's capital resources, particularly in respect of motor vehicles, now in the hands of the public, are being used up faster than they can be replaced. To deal with this threat the Minister of Railways and Harbours and the Minister of Commerce recently established the National Road Transportation Council and an advisory committee representative of the principal interests involved. Wide powers have been delegated to the Council under emergency regulations. It may be necessary to impose a complete or partial ban on certain classes of transport which are deemed to be entirely unnecessary to the national welfare, notwithstanding that they are essential to the individual. However, the Council's first concern will be the elimination of waste, but its work must necessarily proceed piecemeal. Every class of transport and every district in the Union cannot receive attention at the same time. Thus there may be an interval between the time that sacrifices are demanded from one section of the community and that at which another section becomes affected.

South African Industry After the War

Mr. S. F. Waterson, Union Minister of Commerce, declared at a meeting in East London recently that he looked forward to close co-operation between industry and agriculture to their mutual benefit and for the benefit of this country after the war. The

L.M.S. CONVERTED "ROYAL SCOT"



agricultural industry would form an integral part of the post-war development of secondary industries. He thought they could start with the principle that primary products could most profitably be used in South Africa—consumed by man or beast, used in secondary industry, or exploited in their final form. He thought it inevitable that the Transvaal would be the main centre of industries based on iron and steel, but for the rest he believed it to be strongly in the national interest that the factory system should be well distributed throughout the country, provided industries were economically placed for supplies and for distribution. Government would use its influence to maintain a balanced population throughout the country. The border towns he considered well placed for industrial development based on agricultural products, and should play their parts in the future which they were planning.

L.M.S. Rebuilt "Royal Scot" Engines

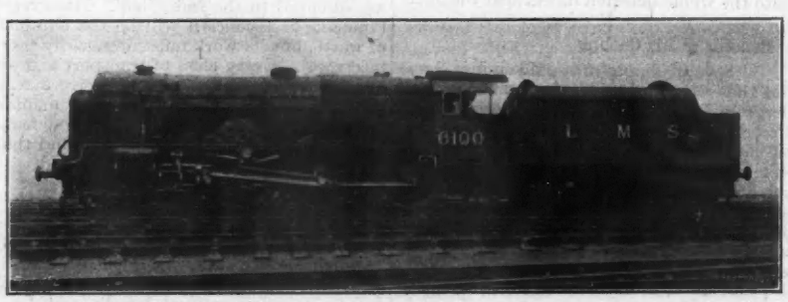
FIFTY "Royal Scot" engines were built in 1927, and twenty in 1930, and many of these are beginning to fall due for new boilers and new cylinders. It has been decided, therefore, to fit these engines with taper boilers and newly designed cylinders, and at the same time to carry out other slight modifications with a view to standardisation.

The boiler which will be used is the same as that with which the "Jubilee" class 4–6–0 three-cylinder 5X engines are being reboilered, thus making one boiler interchangeable between the two classes.

The conversion of the first batch of twenty "Royal Scots" has been authorised, and the work is being carried out in Crewe works. The first engine to be completed was No. 6103 "Royal Scots Fusilier," which was put into traffic in June, 1943. Eventually, the whole of the class will be dealt with in a similar manner. The rebuilt engines will be known as the "Converted Royal Scot" class.

The accompanying engravings show engine No. 6103 contrasted with an earlier engine, No. 6100, and a comparison of the principal dimensions of the two types is given below :—

	Original series, as fitted with high-capacity tenders.	"Converted Royal Scot" class.
Cylinders (three) ...	18in. by 26in.	18in. by 26in.
Wheels, coupled ...	6ft. 9in.	6ft. 9in.
Wheels, bogie ...	3ft. 3½in.	3ft. 3½in.
Wheel base :		
Coupled	15ft. 4in.	15ft. 4in.
Total, engine and tender	54ft. 5½in.	54ft. 5½in.
Length over buffers	64ft. 11in.	64ft. 11in.
Heating surface :		
Tubes	1892 sq. ft.	1667 sq. ft.
Fire-box	189 sq. ft.	195 sq. ft.
Superheater ...	399 sq. ft.	357 sq. ft.
Boiler pressure ...	250 lb. sq. in.	250 lb. sq. in.
Grate area	31·2 sq. ft.	31·25 sq. ft.
Tractive effort, 85 per cent. boiler pressure	33,150 lb.	33,150 lb.
Weight :		
Engine, working order	84 tons 18 cwt.	83 tons
Tender	54 tons 13 cwt.	54 tons 13 cwt.
Total	139 tons 11 cwt.	137 tons 13 cwt.
Water capacity ...	4000 gallons	4000 gallons
Coal	9 tons	9 tons



"ROYAL SCOT" OF 1930

A "Practical Planning" Exhibition

PARTICULARS are now announced concerning the "Practical Planning" Exhibition, which has been arranged by the Institution of Civil Engineers and the Institution of Municipal and County Engineers and will be held at the Institution of Civil Engineers, Great George Street, Westminster. It will be opened by the Right Hon. W. S. Morrison, Minister of Town and Country Planning, on Tuesday, October 5th, at 3 p.m., and will be open to the public every weekday from October 6th to 30th, from 10 a.m. to 6 p.m. No charge will be made for admission, and tickets will not be required except for admission to conferences. Conferences have been arranged to take place at 2.30 p.m. on Wednesdays, October 6th, 13th, 20th, and 27th, when papers will be presented on "The Respective Parts to be Played by the Engineer, the Architect, and the Surveyor in Town and Country Planning," "The Development of Regional Water Supplies and Main Drainage," "Improved Methods of Lay-out and Construction of Roads and the Construction of Motorways, with Special Reference to Safety on Roads," and "Alternative Materials and Methods of Construction in Buildings." Special days for visits by the local associations of the Institution of Civil Engineers and the various Districts of the Institution of Municipal and County Engineers have been arranged, and arrangements are being made for groups of the older boys and girls at schools and colleges to be taken round the exhibition. Two conferences, especially for women, will be held on October 21st, at 10.30 a.m. and 2.30 p.m., when "The Planning of a Town as Affecting a Home" and "The Planning of a Home" will be discussed. The object of the exhibition is to bring out the importance of adequate attention being paid to physical and economic factors, as well as to æsthetic values, for a logical sequence being followed in planning of co-operation between the engineer and all the interests concerned from the start, and of making full use of the assistance which engineering science can offer in the development of Great Britain. The national problem and the necessity for national and regional planning are stated, and the principles and sequence to be followed are fully illustrated by models, photographs, and plans.

Markets, Notes and News

The prices quoted herein relate to bulk quantities. Unless otherwise specified home trade quotations are delivered f.o.t. Export quotations are f.o.b. steamer.

New Selling Basis for Black Bolts and Nuts

It is announced by the Black Bolt and Nut Association of Great Britain that the Ministry of Supply, Iron and Steel Control, have sanctioned the adoption of a new selling basis for the above products, in the form of a standard trade price list per 100 units, which will be subject to a specified discount variable from time to time. This new price list becomes a related schedule under the Control of Bolts, Nuts, Screws, Screw Studs, Washers and Rivets (No. 3) Order, 1943, in force as from October 3rd, 1943, copies of which may be obtained from H.M. Stationery Office, 43, Adastral House, Kingsway, London, W.C.2. The issue of this new price list means that as from October 3rd, 1943, all buyers of black bolts, nuts, set pins, coach screws, &c., will be required to place their orders by count and not by weight, and these will be executed and invoiced by the manufacturers at the new standard trade price list per 100 units, subject to a specified trade discount. On the other hand, carriage bolts and nuts will for the present continue to be sold at prices per gross as heretofore. It is pointed out that the new selling basis thus introduced is the result of cost ascertainment carried out by the industry and is intended to remove some of the anomalies which existed on the old weight basis. In addition, for post-war export trade the new basis has the advantage that prices are expressed per 100 units in conformity with the selling basis of many of the overseas markets. The reference to the Stationery Office means that copies of Order No. 3 can be so obtained. The Related Schedule, which gives the prices, can be seen at the offices of the Iron and Steel Control.

The Pig Iron Market

On the whole the situation in the British pig iron market is satisfactory and production seems to have improved during recent weeks. The raw material position is favourable and supplies of iron ore from North Africa have enabled the production of medium and low-phosphoric pig iron to be expanded, whilst the output of high-phosphoric pig iron has been well maintained as a result of the big production of domestic iron ore. There is also no lack of fuel and liberal quantities of coke are available for blast-furnaces. Most consumers have placed their allocations for delivery in the fourth period, and it is evident the pig iron producers have a busy time before them until the end of the year. The foundry trades are busy, particularly the engineering foundries. At the same time, a demand for foundry iron generally has been on a somewhat lower scale than at the commencement of the three former delivery periods of the year. There is a moderately active request for high-phosphoric pig iron and considerable quantities are passing to the East Coast, where the local make of foundry iron is inconsiderable as the blast-furnace industry in that district has concentrated upon the production of hematite and basic pig iron for the steel works. The consumers of ordinary foundry pig iron, however, are suffering no inconvenience, as they are able to obtain liberal supplies from Midland producers. In the North of England generally consumers have shown no particular anxiety to take up large supplies of No. 3 foundry pig iron, although the requirements of the heavy electrical engineers and the machine tool foundries appear to approximate to those of recent months. The textile machinery foundries and the light castings foundries, however, are taking less than their usual quantities, and this gives the market in Lancashire and surrounding districts a dull appearance. Consumers who are anxious to cover their forward requirements find that licences are being issued on a reasonably liberal scale and have no complaints on this score. The demand for hematite is still in excess of the production, but the output is improving and there seems a likelihood that easier conditions will develop in the not distant future. There has also been a strong request for refined pig iron and low and medium-phosphoric pig iron. These descriptions are being distributed by the Control, which allocates specific quantities weekly, and there has been no difficulty in consumers employed upon Government work obtaining their full requirements. The steel production is maintained at a high level and there is an insistent demand for basic pig iron, but supplies are sufficient to meet the requirements of the industry.

Scotland and the North

The whole of the Scottish steel works' capacity is employed and almost entirely upon war work. There is no doubt in the industry that it will be able to meet the growing demand, although it is realised that the pressure upon the steel works will be severe from now until the end of the year and probably well beyond. The shipyards have a big programme of naval and mercantile construction in hand and their requirements for shipbuilding steel are on an extremely heavy scale. The demand for plates, which has been a feature of the market for so long, has not relaxed, and large tonnages are passing to the yards. Other important consumers are also taking up big quantities, including tank makers, wagon builders, and locomotive builders. The plate mills, in fact, are stretched to the limit to meet the demand, and it is not expected there will be any relief for an indefinite period. The structural steel position is satisfactory, since the demand is being fully met by the producing works. It is possible to place orders for the heavier sizes of joists and sections for near delivery but the steel works and re-rollers are fully engaged upon light sections and most works quote for forward delivery. Constructional engineers are well employed as a rule, although in many cases the work in hand differs from that which they normally undertake. The prefabrication of light naval vessels is continuing on a considerable scale, but most of the plates required for this work are provided by the Control from the stocks of imported material. The demand for sheets has increased during the past week or two and is now keeping pace with output. The mills are fully employed for the remainder of the current period and makers are not anxious to add to their commitments. In the Lancashire steel market the demand for nickel and other alloy steels is an outstanding feature. New business in this department has increased, and it is expected that the requirements of the aircraft manufacturers will be larger than in the past. There is a big volume of business passing in steel bars. The larger sizes are in strong request from the engineering trades and there is a brisk demand for small bright-drawn descriptions. In this department delivery periods show a tendency to lengthen, particularly for the larger diameters. No change has occurred in the plate position and the consumers' requirements are testing the resources of the producing works. On the North-West Coast the steel works are meeting with an insistent demand, which is spread over all the finishing departments. Big tonnages of structural steel, rails, and semi-finished steel are being produced.

North-East Coast and Yorkshire

For a long time now plant and workmen at the iron and steel works on the North-East Coast have been working at unceasing pressure, and this condition is likely to continue for an indefinite period. The steel works are heavily booked and it is difficult to find works in a position to accept fresh orders for delivery before some time in January. The re-rolling works also are fully booked until early next year, but fortunately there is no difficulty with regard to the raw materials position. Regular supplies of billets, blooms, and sheet bars are being received. Most of the re-rolling works are employed in producing light angles and tees, but most of them are carrying heavy orders for small steel bars and there is a good demand for strip. Recently there has been some complaint that flat billets are not easily obtained, although this is probably only a temporary phase. The sheet works are holding sufficient orders to keep them well employed into the first delivery period of next year, and there is no difficulty in obtaining all the sheet bars they require. The re-rolling works are using good quantities of defectives and stocks of these have accumulated. There is also a demand for shell discard semis, but supplies of these appear to have declined recently, probably as a result of changes in the war production programme. Although there is an insistent demand for the smaller sizes of structural steel, the call for the heavier sizes is not more than moderate. This is probably because the volume of work in erecting new factories and extending others has passed the peak. The pressure to obtain plates shows no signs of relaxing, and the requirements of the shipbuilding industry, which is taking the greater proportion of the output, show no signs of declining. The manner in which the steel industry has met the enormous plate requirements of the shipyards is a matter for congratulation. The operations of the Yorkshire steel industry are fully maintained and all the finishing departments have sufficient work in hand to keep them employed for some months. The production of basic steel has been maintained at the maximum for a long time and there has been a heavy demand for acid carbon steel. Alloy steel has been produced in comparatively large quantities and there are indications that the demand for this class of steel will increase. The war industries are taking up large tonnages of steel castings and the producing works are fully employed.

The Midlands and South Wales

The steel works in the Midlands, without exception, are meeting with heavy pressure from consumers. The re-rolling works are fully employed, but are receiving adequate supplies of billets and sheet bars. More liberal supplies of flat billets, however, would be welcome in some cases. The production of small steel bars and the smaller sizes of structural steel is on a heavy scale, but production goes immediately into consumption. Constructional engineers are busy and, excepting in heavy joists and sections, their requirements of structural steel are considerable. On the other hand, the heavier sizes are obtainable for reasonably near delivery. The outstanding demand for plates, which has existed for some months, shows no signs of decreasing, and the resources of the works are severely taxed to meet the insistent call. Thick sheets are also being produced in considerable quantities and are helping to relieve the pressure for thin plates. The requirements of the shipyards for plates and thick sheets are given priority consideration and, in spite of the enormous amount of work proceeding at the yards, there is no hold-up on account of belated deliveries of this material. The heavy demand for alloy steel is being adequately met, but there are expectations that the requirements of the aircraft industry and makers of military mechanical equipment will increase in the near future. The collieries are taking up considerable quantities of steel in the form of arches, roofing bars, and rails. Their requirements are looked after by the Ministry of Fuel and Power, and the needs of the mines are being fully met by the steel industry. There is a brisk demand for iron bars, but although fair quantities of crown bars are passing into consumption, the volume of business in Nos. 3 and 4 bars is much greater. Heavy war requirements keep South Wales iron and steel works engaged at capacity. Production of plates is well maintained and large tonnages are passing to the shipyards and ship repairing yards, whilst other consumers are taking up large quantities. The production of billets has increased lately and there is a steady demand for sheet and tinplate bars. The tinplate industry, however, is quiet. Export business has been limited to a few transactions, whilst the home demand has declined somewhat. All the sheet works are actively engaged.

Non-Ferrous Metals

The non-ferrous metal position in Great Britain appears to be reasonably comfortable. The consumption for war purposes stands at record levels and, of course, this means that as supplies of copper, tin, lead, and spelter have to be imported, arrivals must be regular and adequate. It is generally understood that the agreements entered into by the Government at the commencement of the war for supplies from the Empire producers are working well, and that although there have been some slight adjustments there is no reason why they should not continue in operation for the remainder of the war, to the mutual benefit of this country and the producers. There is a huge consumption of copper and, naturally, the brass manufacturers are amongst the largest consumers. Recently the situation has had a somewhat easier appearance, although at no time has there been any apparent stringency in the position of this metal. The firms engaged upon war work have always been able to get full supplies, but for a long time there has been no surplus for ordinary commercial or domestic purposes. The slightly easier conditions are probably due to changes which have occurred in the production of some descriptions of war material. The tin position needs to be most carefully controlled, as owing to the Japanese invasions in the Far East several valuable sources of supply have been lost to the Allies. By ruthlessly cutting down the use of tin wherever possible and by expanding production in those countries under the control of the Allies the situation appears to have been made secure for the remainder of the war. The lead position, too, is satisfactory, although the Non-Ferrous Metal Control has to maintain a careful supervision over the distribution of the metal. At one time during the war lead was the non-ferrous metal in most liberal supply, but the course of the war in the Far East has had a pronounced influence upon supplies to this country and wartime regulations have had to be brought into operation to restrict the use of the metal to essential needs. The zinc position has been tight practically from the day war was declared, and the restrictions designed to conserve the metal have been more drastic than in the case of other non-ferrous metals. Firms employed on war work, however, receive their essential supplies, and the public has not suffered any hardship through lack of spelter.

Notes and Memoranda

Rail and Road

ELECTRIC RAILWAYS IN SPAIN.—Reports from Madrid indicate that Spain's electric railways are to be considerably extended during the next twelve years. The plans provide for about 2500 miles of single track to be converted at the rate of 200 miles a year. The cost is estimated at about four million pounds.

TRANSPLANTING RAILWAY SIDINGS.—No fewer than 848 railway sidings, thirty bridges, sixty-eight engine turntables, and six disused stations are being demolished by the L.M.S. Railway and the materials used elsewhere. Altogether, these demolitions will provide 22,000 tons of iron and steel, 5600 tons of timber, and 5000 tons of bricks.

SOUTH AFRICAN PROSPERITY.—A quarter's earnings of the South African Railways and Harbours for the period April 1st to June 26th during the current and past financial years show that trade is flourishing. Returns are up by more than £800,000, passenger traffic being responsible for three-fifths of the increase. Coal and harbour dues show slight decreases.

AN ANCIENT HIGHWAY.—So many highways are in progress in America and Canada that one transatlantic journal has thought fit to remind its subscribers that the Incas and their predecessors in Peru built a remarkable highway approximately 4000 miles in length, dating back to about A.D. 100 Much of this road had deep foundantions, was surfaced with cut stone, and was 20ft. wide. A large portion of the highway was surfaced with asphalt and is so well preserved that long sections of it are still in use.

REVISED RECOMMENDATIONS FOR TAR CARPETS.—In 1941 the Road Research Laboratory began a series of Wartime Road Notes dealing with problems of road building and maintenance created by war conditions. The first Note, which gave recommendations for tar carpets and surface dressings, has now been revised, and the first part concerning tar carpets has been issued as Wartime Road Note No. 7. Although in essentials the present revision does not differ materially from the original recommendations for tar carpets, slight modifications, mainly in the tolerances allowed in the grading of the aggregates, have been made as a result of evidence obtained from further experimental work and from the reports of practical experience from various parts of the country. The opportunity has also been taken to extend the range of the recommendations to include carpets made with ¾in. aggregates and cold-laid materials. As was stated in the original Note, the recommendations put forward are not intended to supersede the use of other methods or materials where these have proved their value. The revised Note is published by H.M. Stationery Office, price 7d. post free.

Air and Water

FLOATING POWER PLANTS.—At a cost of 13 million dollars U.S. Army engineers have been equipped with four barges, 250ft. long, and capable of producing at capacity 30,000 kW of electric power, sufficient to supply power for several war production plants or in an emergency an entire town of no mean size.

TABLE BAY HARBOUR.—Good progress on the Table Bay harbour and graving docks has been made during recent months, and the City Engineer's Department is now pushing ahead with its plans for the foreshore lay-out. The City Engineer is obtaining the advice of a special committee of architects, and it is anticipated that shortly he will give a report of the decisions taken.

A MAGNET FOR SALVING IRON.—It is reported from New Zealand that the first sea tests have been made of a powerful electro-magnet for salving iron and steel from the cargo of the "Waikouaiti," off Dog Island, Bluff. The magnet weighs 650 lb. The internal wiring has been carefully sealed to make it waterproof, and the cable is shielded by a rubber hose. The power is supplied by a generator coupled to a motor-car engine. According to the specifications, the magnet will be effective for loads of up to 6 tons, with a full margin of safety.

SHIP REPAIRING IN SOUTH AFRICA.—Engineers at the Cape are undertaking a good many repairs to ships. In this work they have had the skilled assistance of certain Dutch marine engineers and other overseas experts. Time has been saved in certain major shipping repairs by the expedient of lowering one part of the ship so that the bows or stern may be raised and the necessary operations on the keel plates performed from pontoons. A number of ships damaged by enemy action have thus either been rendered sufficiently seaworthy to return to a port in the United States or Britain for more permanent attentions or for ordinary sea service.

Miscellanea

CARDBOARD PETROL CONTAINERS.—Whether it is better to economise on paper or metal has been solved in the U.S.A., where petrol for tanks and aeroplanes is being carried in containers made of specially treated cardboard. Being an insulator, the material has in some cases been found to be safer than tinplate, because it offers greater protection against the dangers of contact with electric currents.

ELECTRICITY SUPPLY TECHNOLOGY.—The Electricity Commissioners, having asked the Electrical Research Association to institute research into the characteristics of the load produced by resistance welding machines, with a view to establishing a scientific basis for coping with the supply problems involved, the Association has set up a committee composed of representatives of consumers, authorised undertakers, and manufacturers, and the work is now in hand.

SWEDEN'S FOREIGN TRADE.—According to the statistics of the Swedish Board of Trade, imports to Sweden rose by nearly 40,000,000 kr. to 186,300,000 kr. (£10,950,000) during July as a result of the livelier safe conduct traffic with overseas countries. During the same month exports showed a decline of 20,000,000 kr. to 111,900,000 kr. (£6,600,000) as compared with June. The decrease is due mainly to reduced shipments of wood and pulp, as well as of iron ore and metals.

INDIA'S BAUXITE DEPOSITS.—It appears likely that India possesses all the prerequisites for attaining a leading position in the production of aluminium. Rich deposits of bauxite are found in five provinces, and a great amount of low-grade bauxite suitable for an alumina cement in other parts. At present the Aluminium Company of India, Ltd., possesses the only plant in India producing aluminium. It has a fully equipped sheet mill and plans to erect an additional reduction plant soon.

GAUGING BY BLIND PEOPLE.—A new instrument recently demonstrated by E. H. Jones (Machine Tools), Ltd., of London, enables blind workers to check the accuracy of parts to a tenth of a thousandth of an inch. Checking is done by means of bells ringing in different tones. Parts are fed into the machine, a "Sigma" comparator, by hand, and those which are too small or too large are revealed by the ringing of either a high-pitched or low-pitched bell. When the part is dead right for size, the two bells ring together.

ROCK DUST FOR BITUMINOUS COAL MINES.—An increase in the use of rock dust as a preventive or limiting factor against the destruction of life and property caused by explosions of gas or coal dust in bituminous coal mines is revealed by reports from mining companies to the United States Bureau of Mines. The actual quantity of rock dust applied to underground mine workings has more than doubled since 1930, having increased from 137 million pounds in that year to 344 million pounds in 1941, the latest year for which complete information is available. Production of coal from the mines that used rock dust accounted for 33 per cent. of the production from all underground bituminous mines in the United States in 1930, and from this figure the proportion increased to 57 per cent. in 1941. Moreover, the quantity of rock dust used in relation to the output of coal has increased, the record showing less than 1 lb. (0·93) of rock dust employed per ton of coal at rock-dusted mines in 1930 and 1·31 lb. of rock dust per ton of coal produced in 1941. Although reports from the mining companies indicated, in some instances, that the quantity of rock dust used was obviously inadequate when considered in relation to the quantity of coal produced, the record of the past twelve years is encouraging. The mixing of inert rock dust with coal dust throughout the mine workings in proportions to ensure a non-explosive mixture is recommended by the Bureau of Mines as a safeguard against explosions such as those that caused the loss of many lives in the mines in earlier years. The Bureau of Mines is hopeful that the growth in the use of rock dust at bituminous mines will take on a more rapid pace in the future, as such a course affords one of the most promising means of reducing the death-rate from accidents in the coal mines of the United States.

Forthcoming Engagements

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Monday of the week preceding the meetings. In all cases the TIME *and* PLACE *at which the meeting is to be held should be clearly stated.*

Institute of Welding

Wednesday, Oct. 13th.—Conway Hall, Red Lion Square, Holborn, W.C.1. "Some Aspects of Machine Design," E. Hassler. 5.30 p.m.

Institution of Automobile Engineers

Tuesday, Oct. 5th.—Royal Society of Arts, John Adam Street, Adelphi, W.C.2. Presidential Address by G. H. Lanchester. 6.15 p.m.

Institution of Civil Engineers

Saturday, Oct. 9th.—YORKSHIRE ASSOC.: Hotel Metropole, Leeds. Chairman's Address, by K. L. Forster. 2.30 p.m.

Institution of Electrical Engineers

Monday, Oct. 4th.—MERSEY AND N. WALES CENTRE: Liverpool Royal Institution, Colquitt Street, Liverpool. Chairman's Address, "Industrial Power Supply," T. E. Houghton. 5.30 p.m.

Thursday, Oct. 7th.—Savoy Place, Victoria Embankment, W.C.2. Presidential Address, Colonel Sir A. S. Angwin. 5.30 p.m.

Institution of Mechanical Engineers

Saturday, Oct. 2nd.—YORKS BRANCH: Hotel Metropole, Leeds. Chairman's Address, by G. Varley. 2.30 p.m.

Monday, Oct. 4th.—N.E. BRANCH: Mining Institute, Neville Hall, Newcastle-upon-Tyne. "Powder Metallurgy," J. E. Newson. 6 p.m.

Thursday, Oct. 7th.—N.W. BRANCH: Engineers' Club, Albert Square, Manchester. "Practice and Experience in the Production of High-Speed Helical Gears, with Special Reference to the Elimination of Transmission Noises," S. A. Couling. 6.45 p.m.

Saturday, Oct. 9th.—YORKS GRADUATES' SECTION: Hotel Metropole, Leeds. "The Mining and Making of Ferodo," W. S. Blackie. 2.30 p.m.

Institution of Production Engineers

To-day, Sept. 24th.—N.E. SECTION: County Hotel, Newcastle. "Materials and their Applications," W. Scott. 6.30 p.m.

Sunday, Sept. 26th.—LUTON SECTION: The Library, George Street, Luton. "Forging," R. W. Brocklehurst. 10 a.m.

Friday, Oct. 1st.—COVENTRY SECTION: Technical College, Coventry. "Engineering and its Effect on Social Life," Dr. K. G. Fenelon. 6.45 p.m.

Saturday, Oct. 2nd.—YORKS GRADUATE SECTION: Hotel Metropole, Leeds. "The Production of Surface Finish," J. L. Hepworth. 2.30 p.m.

Monday, Oct. 4th.—SHEFFIELD SECTION: Royal Victoria Station Hotel, Sheffield. "High Speed in the Wartime Production Shop," Dr. G. Schlesinger. 6.30 p.m.

Friday, Oct. 8th.—EASTERN COUNTIES SECTION: Ipswich Museum, Ipswich. "Local Hardening," E. Bramhill. 7 p.m. MANCHESTER SECTION: Mechanics' Institute, Crewe. "Production Control," R. Appleby. 7.15 p.m.

Saturday, Oct. 9th.—MANCHESTER SECTION: Liverpool University, Brownlow Hill, Liverpool. "Production Control," R. Appleby. 2.30 p.m. YORKS SECTION: Hotel Metropole, Leeds. "The Production Technique of Industrial Plastic Mouldings," T. H. Richardson. 2.30 p.m.

Monday, Oct. 11th.—COVENTRY GRADUATES' SECTION: Technical College, Coventry. "Any Questions?" 6.45 p.m.

Iron and Steel Institute

Wednesday, Sept. 29th.—Engineers' Club, Albert Square, Manchester. "Lattice Structures in Relation to Physical Properties of Metals," Dr. W. H. Taylor. 6.30 p.m.

Junior Institution of Engineers

To-day, Sept. 24th.—39, Victoria Street, Westminster, S.W.1. "Daylight Illumination in Factories and Workshops," P. J. Waldram. 6.30 p.m.

Friday, Oct. 1st.—39, Victoria Street, S.W.1. Discussion on Post-War Problems. 6.30 p.m.

Saturday, Oct. 2nd.—N.W. SECTION: Manchester Geographical Society. St. Mary's Parsonage, Manchester Informal meeting. 2.30 p.m.

Liverpool Engineering Society

Wednesday, Oct. 6th.—Municipal Annexe, Liverpool. Presidential Address, "A Brief History of the Municipal Services of Liverpool," Major H. Pryce-Jones. 6 p.m.

Manchester Association of Engineers

Friday, Oct. 1st.—Engineers' Club, Albert Square, Manchester. Presidential Address, by J. P. Hallam. 6.30 p.m.

Practical Planning Exhibition

Wednesday to Saturday, Oct. 6th to 30th.—Institution of Civil Engineers, Great George Street, S.W.1. 10 a.m. to 6 p.m. (except Sundays).

Sheffield Metallurgical Association

Tuesday, Sept. 28th.—Royal Victoria Station Hotel, Sheffield. "The Strength of Metals," Professor Sir Lawrence Bragg. 6 p.m.